

November 16, 1894.]

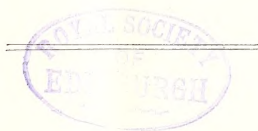
JOURNAL

OF THE

SOCIETY OF ARTS.

VOLUME XLII.

FROM NOVEMBER 17, 1893, TO NOVEMBER 16, 1894.



LONDON :

PUBLISHED FOR THE SOCIETY BY GEORGE BELL AND SONS,
4, 5, & 6, YORK STREET, COVENT GARDEN.

1894.

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JOURNAL OF THE SOCIETY OF ARTS.

No. 2139.]

FRIDAY, NOVEMBER 17, 1893.

[VOL. XLII.

ONE-HUNDRED-AND-FORTIETH SESSION, 1893-94.

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J. OLDFIELD CHADWICK AND SON.

SESSIONAL ARRANGEMENTS.

The First Meeting of the One Hundred and Fortieth Session of the Society was held on Wednesday, the 15th November, when the Opening Address was delivered by Sir RICHARD WEBSTER, Q.C., M.P., Chairman of the Council. The following arrangements have been made for the four meetings before Christmas:—

NOVEMBER 22.—CAPT. M. H. HAYES, "Conformation of the Horse from the Artistic Point of View."

„ 29.—RICHARDSON EVANS, "The Regulation of Street Advertising." Sir GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

DECEMBER 6.—FREDERIC VILLIERS, "An Artist's View of Chicago and the World's Fair."

„ 13.—LEWIS H. ISAACS, "Carriage-way Pavements for large Cities."

Papers for meetings after Christmas:—

W. WORBY BEAUMONT, "Automatic Balance of Reciprocating Machinery, and the Prevention of Vibration."

HIRAM S. MAXIM, "Experiments in Aeronautics."

W. G. LOCKHART, "Automatic Gem and Gold Separator."

HENRY ROBINSON, M.Inst.C.E., "The St. Pancras Electric Light Installation."

HORACE TOWNSEND, "Modern Development of Illustrated Journalism."

PERCY FITZGERALD, M.A., "The Adam Architecture in London."

J. STARKIE GARDNER, "Pewter."

WILLIAM HENRY PREECE, F.R.S., "Electric Signalling without Wires."

PROF. VIVIAN LEWES, "London Coal Gas and its Enrichment."

JOSEPH WALTON, "Railway Extension in India."

R. D. OLDHAM, F.G.S., "The Petroleum Fields of India: their Present and Future."

J. BARR ROBERTSON, "The Indian Currency."

E. O. WALKER, C.I.E., M.I.E.E., "Telegraphic Communication between England and India: its Condition and Future Developments."

J. F. HEWETT, "Chota Nagpore: its Mineral Wealth and Industrial Resources and its Value to India."

EDOUARD SÈVE, "The Forthcoming Antwerp Exhibition."

SIR AUCLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieutenant-Governor of the North-Western Provinces and Oudh, "The Water Supply and Sanitation of the North-Western Provinces and Oudh."

CAPTAIN ROLLESTON, "Morocco."

A. F. BAILLIE, "Paraguay."

INDIAN SECTION.

Thursday Afternoons, at Half-past Four o'clock:—Jan. 18, Feb. 15, March 8, April 5, 26, May 24.

FOREIGN AND COLONIAL SECTION.

Tuesdays, at Half-past Four or Eight o'clock:—Jan. 23, Feb. 20, March 6, April 17, May 1, 29.

APPLIED ART SECTION.

Tuesday Evenings, at Eight o'clock:—Jan. 30, Feb. 13, 27, March 13, April 10, May 8.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

HENRY BLACKBURN, "The Art of Book and Newspaper Illustration." Three Lectures.

LECTURE I.—NOVEMBER 27.—*The Illustrator of To-day*.—Education of the artist—Drawing for reproduction—Modern methods and requirements—Influence of photography on the illustrator—Examples of drawings for reproduction good and bad.

LECTURE II.—DECEMBER 4.—*The Engraver*.—The various methods of reproducing drawings and photographs for the press.—The substitution of photographic and mechanical engraving for handwork—Specimens of the newest processes of illustration.

LECTURE III.—DECEMBER 11.—*The Author*.—His part in the illustration of books—His handwriting—The decorative, page—Examples of illustration—Archaic decorative, topical—The Book of the Past—The Book of the Future.

PROFESSOR FRANK CLOWES, D.Sc., "The Detection and Measurement of Inflammable Gas and Vapour in the Air." Four Lectures. January 22, 29, Feb. 5, 12.

HUGH STANNUS, F.R.I.B.A., "The Decorative Treatment of Traditional Foliage." Four Lectures. February 19, 26, March 5, 12.

CAPTAIN W. DE W. ABNEY, C.B., F.R.S., "Photometry." Three Lectures. April 2, 9, 16.

HENRY CHARLES JENKINS, A.M.Inst.C.E., "Typewriting Machines." Two Lectures. April 30, May 7.

JUVENILE LECTURES.

Two lectures, by WALTER GARDINER, M.A., F.R.S., on "Plants: their Foes and Defences," on Wednesday evenings, January 3 and 10, 1894, at 7 p.m.

PROCEEDINGS OF THE SOCIETY.

CHARTER.—THE SOCIETY OF ARTS was founded in 1754, and incorporated by Royal Charter in 1847, for "The Encouragement of the Arts, Manufactures, and Commerce of the Country, by bestowing rewards for such productions, inventions, or improvements as tend to the employment of the poor, to the increase of trade, and to the riches and honour of the kingdom; and for meritorious works in the various departments of the Fine Arts; for Discoveries, Inventions, and Improvements in Agriculture, Chemistry, Mechanics, Manufactures, and other useful Arts; for the application of such natural and artificial products, whether of Home, Colonial, or Foreign growth and manufacture, as may appear likely to afford fresh objects of industry, and to increase the trade of the realm by extending the sphere of British commerce; and generally to assist in the advancement, development, and practical application of every department of science in connection with the Arts, Manufactures, and Commerce of this country."

THE SESSION.—The Session commences in November, and ends in June. The number of Meetings held during the Session amounts to between 70 and 80.

ORDINARY MEETINGS.—At the Wednesday Evening Meetings during the Session, papers on subjects relating to inventions, improvements, discoveries, and other matters connected with the Arts, Manufactures, and Commerce of the country are read and discussed.

INDIAN SECTION.—This Section was established in 1869, for the discussion of subjects connected with our Indian Empire. Six or more Meetings are held during the Session.

FOREIGN AND COLONIAL SECTION.—This Section was formed in 1874, under the title of the African Section, for the discussion of subjects connected with the Continent of Africa. It was enlarged in 1879, so as to include the consideration of subjects connected with our Colonies and Dependencies, and with Foreign Countries. Six or more Meetings are held during the Session.

APPLIED ART SECTION.—This Section was formed in 1886, for the discussion of subjects connected with the industrial applications of the Fine Arts. Six or more meetings are held during the Session.

CANTOR LECTURES.—These Lectures originated in 1863, with a bequest by the late Dr. Cantor. There are several Courses every Session, and each course consists generally of two or more Lectures.

ADDITIONAL LECTURES.—Special Courses of Lectures are occasionally given.

JUVENILE LECTURES.—A short Course of Lectures, suited for a Juvenile audience, is delivered to the Children of Members during the Christmas Holidays.

ADMISSION TO MEETINGS.—Members have the right of attending the above Meetings and Lectures. They require no tickets, but are admitted on signing their names. Every member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor and other Lectures. Books of tickets for the purpose are supplied to the Members, but admission can be obtained on the personal introduction of a Member. For the Juvenile Lectures special tickets are issued.

JOURNAL OF THE SOCIETY OF ARTS.—The *Journal*, which is sent free to Members, is published weekly, and contains full Reports of all the Society's Proceedings, as well as a variety of information connected with Arts, Manufactures, and Commerce.

EXAMINATIONS.—Examinations are held annually by the Society, through the agency of Local Committees, at various centres in the country. They are open to any person. The subjects include the principal divisions of a Commercial Education, Domestic Economy, and Music. A Programme, containing detailed information about the Examinations, can be had on application to the Secretary.

LIBRARY AND READING-ROOM.—The Library and Reading-room are open to Members, who are also entitled to borrow books.

CONVERSAZIONI are held, to which the Members are invited, each member receiving a card for himself and a lady.

MEMBERSHIP.

The Society numbers at present between three and four thousand Members. The Annual Subscription is Two Guineas, payable in advance, and dates from the quarter-day preceding election; or a Life Subscription of Twenty Guineas may be paid.

Every Member whose subscription is not in arrear is entitled:—

To be present at the Evening Meetings of the Society, and to introduce two visitors at such meetings, subject to such special arrangements as the Council may deem necessary to be made from time to time.

To be present and vote at all General Meetings of the Society.

To be present at the Cantor and other Lectures, and to introduce one visitor.

To have personal free admission to all Exhibitions held by the Society at its house in the Adelphi.

To be present at all the Society's *Conversazioni*.

To receive a copy of the Weekly *Journal* published by the Society.

To the use of the Library and Reading-room.

Candidates for Membership are proposed by three Members, one of whom, at least, must sign on personal knowledge; or are nominated by the Council.

All subscriptions should be paid to the Secretary, Sir Henry Trueman Wood, and all Cheques or Post-office Orders should be crossed "Coutts and Company," and forwarded to him at the Society's House, John-street, Adelphi, London, W.C.

HENRY TRUEMAN WOOD, *Secretary*.

CALENDAR FOR THE SESSION.

The following is the Calendar for the Session 1893-94. It is issued subject to any necessary alterations:—

NOVEMBER, 1893.			DECEMBER, 1893.			JANUARY, 1894.			FEBRUARY, 1894.		
1	W		1	F		1	M		1	T	
2	Th		2	S		2	Tu		2	F	
3	F		3	S		3	W	Juvenile Lecture I.	3	S	
4	S		4	M	Cantor Lecture I. 2	4	Th		4	S	
5	M		5	Tu	Ordinary Meeting	5	F		5	M	Cantor Lecture II. 3
6	W		6	W		6	S		6	Tu	
7	Th		7	Th		7	S		7	W	Ordinary Meeting
8	F		8	F		8	M		8	Th	
9	Th		9	S		9	Tu		9	F	
10	S		10	S		10	W	Juvenile Lecture II.	10	S	
11	M		11	M	Cantor Lecture I. 3	11	Th		11	M	
12	Tu		12	Tu	Ordinary Meeting	12	F		12	Tu	Cantor Lecture II. 4
13	W		13	W		13	S		13	W	Applied Art Section
14	Th		14	Th		14	M		14	Th	Ordinary Meeting
15	F	Ordinary Meeting (Opening Meeting of the Session)	15	F		15	Tu		15	F	Indian Section
16	S		16	S		16	W		16	S	
17	M		17	M		17	Th	Ordinary Meeting Indian Section	17	S	
18	Tu		18	Tu		18	F		18	M	Cantor Lecture III. 1
19	W		19	W		19	S		19	Tu	For. & Col. Section
20	Th		20	Th		20	M		20	W	Ordinary Meeting
21	F	Ordinary Meeting	21	F		21	Tu		21	Th	
22	S		22	S		22	W	Cantor Lecture II. 1	22	F	
23	M		23	M		23	Th	For. & Col. Section	23	S	
24	Tu		24	Tu		24	F	Ordinary Meeting	24	M	
25	W		25	W	CHRISTMAS DAY Bank Holiday	25	Th		25	S	Cantor Lecture III. 2
26	Th		26	Th		26	M		26	Tu	Applied Art Section
27	F	Cantor Lecture I. 1	27	F		27	W		27	W	Ordinary Meeting
28	S		28	S		28	Th				
29	M	Ordinary Meeting	29	M		29	F	Cantor Lecture II. 2			
30	Tu		30	Tu		30	Tu	Applied Art Section			
31	W		31	W		31	W	Ordinary Meeting			

MARCH, 1894.			APRIL, 1894.			MAY, 1894.			JUNE, 1894.		
1	Th		1	S		1	Tu	For. & Col. Section	1	F	
2	F		2	M	Cantor Lecture IV. 1	2	W	Ordinary Meeting	2	S	
3	S		3	Tu		3	Th		3	M	
4	M	Cantor Lecture III. 3	4	W	Ordinary Meeting	4	F		4	Tu	
5	Tu	For. & Col. Section	5	Th	Indian Section	5	S		5	W	
6	W	Ordinary Meeting	6	F		6	M		6	Th	
7	Th	Indian Section	7	S		7	Tu	Cantor Lecture V. 2	7	F	
8	F		8	M	Cantor Lecture IV. 2	8	W	Applied Art Section	8	S	
9	Th		9	Tu	Applied Art Section	9	Th	Ordinary Meeting	9	M	
10	S		10	W	Ordinary Meeting	10	F		10	Tu	
11	M	Cantor Lecture III. 4	11	Th		11	S		11	W	
12	Tu	Applied Art Section	12	F		12	Th	WHIT SUNDAY	12	Th	
13	W	Ordinary Meeting	13	S		13	M	Bank Holiday	13	F	
14	Th		14	Tu		14	Tu		14	S	
15	F		15	W	Cantor Lecture IV. 3	15	W		15	M	
16	S		16	Th	For. & Col. Section	16	Th		16	Tu	
17	M		17	F	Ordinary Meeting	17	F		17	W	
18	Tu		18	S		18	S		18	Th	
19	W		19	M		19	Tu		19	F	Conversazione
20	Th		20	Tu		20	W	Cantor Lecture	20	S	
21	F		21	W		21	Th		21	M	
22	S	GOOD FRIDAY	22	Th		22	F	Ordinary Meeting	22	Tu	
23	M		23	F		23	S	Indian Section	23	W	
24	Tu	EASTER SUNDAY	24	S		24	Th		24	Th	
25	W	Bank Holiday	25	M	Ordinary Meeting	25	M		25	F	
26	Th		26	Tu	Indian Section	26	Tu		26	S	
27	F		27	W		27	W		27	M	Annual General Meeting
28	S		28	Th		28	Th	Cantor Lecture	28	Tu	
29	M		29	F		29	F	For. & Col. Section	29	W	
30	Tu		30	S		30	S	Ordinary Meeting	30	Th	
31	W			M	Cantor Lecture V. 1	31	Th				

The chair will be taken at Eight o'clock at each of the Ordinary Meetings, the Cantor Lectures, and the Meetings of the Applied Art Section.

The Meetings of the Indian Section will commence at Half-past Four o'clock.

The Meetings of the Foreign and Colonial Section will commence at either Half-past Four or Eight o'clock, as may be announced from time to time.

The Annual General Meeting will be held at Four o'clock

The Juvenile Lectures will be given at Seven o'clock.

Notices.

SWINEY PRIZE.

The Council have to give notice that the next award of the Swiney prize will be in January next. Dr. Swiney died in 1844, and in his will he left the sum of £5,000 Consols to the Society of Arts, for the purpose of presenting a prize, every fifth anniversary of the testator's death, to the author of the best published work on Jurisprudence. The prize is a cup, value £100, and money to the same amount; the award is made jointly by the Society of Arts and the College of Physicians. The cup now given is made after a design specially prepared in 1849 for the first award, by D. Maclise, R.A. Any person desiring to submit a work in competition, or to recommend any work for the consideration of the judges, should do so by letter, addressed to the Secretary of the Society.

The following is the list of recipients :—

- 1849. J. A. Paris, M.D., and J. Fonblanque, for their work, "Medical Jurisprudence."
- 1854. Leone Levi, for his work on "The Commercial Law of the World."
- 1859. Dr. Alfred Swayne Taylor, F.R.S., for his work on "Medical Jurisprudence."
- 1864. Henry Summer Maine (afterwards K.C.B.), D.C.L., Member of the Legislative Council of India, for his work on "Ancient Law."
- 1869. William Augustus Guy, M.D., for his "Principles of Forensic Medicine."
- 1874. The Right Hon. Sir Robert Joseph Phillimore, D.C.L., for his "Commentaries on International Law."
- 1879. Dr. Norman Chevers, for his "Manual of Medical Jurisprudence for India."
- 1884. Sheldon Amos, M.A., for his work, "A Systematic View of the Science of Jurisprudence."
- 1889. Dr. Charles Meymott Tidy, F.C.S., for his work, entitled "Legal Medicine."

Chicago Exhibition, 1893.

MEETING OF THE ROYAL COMMISSION.

A meeting of the Royal Commission was held on Monday, 13th inst., at 4.30 p.m. Present :— Sir Richard Webster, Q.C., M.P., in the chair ; Sir Frederick Abel, Bart., K.C.B., D.C.L.,

D.Sc., F.R.S., Sir George Birdwood, K.C.I.E., C.S.I., LL.D., M.D., Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Major-General Sir Owen Tudor Burne, K.C.S.I., C.I.E., Michael Carteighe, Francis Cobb, Prof. James Dewar, M.A., LL.D., F.R.S., Sir Henry Doulton, James Dredge, Prof. Clement Le Neve Foster, D.Sc., F.R.S., Sir Douglas Galton, K.C.B., D.C.L., F.R.S., Walter H. Harris, Charles Malcolm Kennedy, C.B., Sir Villiers Lister, K.C.M.G., John Fletcher Moulton, Q.C., F.R.S., John O'Connor, W. B. Perceval, Gen. the Rt. Hon. Sir Henry F. Ponsonby, G.C.B., Professor William Chandler Roberts-Austen, C.B., F.R.S., Sir Owen Roberts, M.A., D.C.L., F.S.A., with Sir Henry Trueman Wood, M.A., Secretary.

Proceedings of the Society.

FIRST ORDINARY MEETING.

Wednesday, Nov. 15, 1893 ; Sir RICHARD E. WEBSTER, Q.C., M.P., Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society :—

- Adam, Peter, Cairndhu, Kidderminster.
- Ahmed, Sayyed Zaheer Uddin, B.A., care of Hutchinson and Co., 1, Northumberland-avenue, W.C.
- Ahsanulla, Nawab, The Hon. Khwaja, C.I.E., Dacca, Bengal.
- Annandale, Charles J. R., 265, Queen's-road, New-cross-gate, S.E.
- Ansted, William Alexander, 3, Ranelagh-villas, Grove-park, Chiswick.
- Barrett, Walter, 135, Church-street, Chelsea, S.W.
- Beaumont, W. Worly, M.I.C.E., 100, Palace-road, Tulse-hill, S.W.
- Becker, Harry Otto, The Minorities, All Saints', Colchester
- Bevan, Paul, M.A., 46, Queen's-gate-terrace, S.W.
- Birch, Colonel Robert Graham, 9, Montague-avenue, Brockley, S. E.
- Bishop, Edward Francis, India-office, Whitehall, S.W.
- Boulton, James, Crayford Mills, Stratford, E.
- Bristow, George William, 102, Manor-road, Brockley, S.E.
- Buckmaster, Martin Arnold, 22, Talgarth-road, West Kensington, W., and Ashleigh, Hampton Wick.
- Bull, John C., 18, Bexley-road, Erith, Kent.
- Bumsted, David Alexander, Blyth-road, Bromley, Kent.
- Burt, Charles William, 26, Westbourne-park-villas, Bayswater, W.

- Cadett, James, Ashtead, Surrey.
- Caird, David, Hyde-park-court, W., and Todleusk, Ulverston, Lancashire.
- Caulfield, Francis, Edington, Langside, Glasgow.
- Cecil, Lieut.-Col. Lord William, 87, Queen's-gate, S.W.
- Chalmers, John Hicklenton, The Elms, Highgate-road, N.W.
- Chance, George Ferguson, M.A., Clent-grove, near Stourbridge.
- Christy, Gerald, 38, Outer Temple, E.C.
- Cleghorn, William, jun., Clepington, Dundee, and Bayfield, Broughty Ferry.
- Collins, Richard, 1, London-road, High Wycombe, Bucks.
- Crosthwaite, Sir Charles H. T., K.C.S.I., Naini Tal, India.
- Croweller, William Thomas, F.I.Inst., Cyclists' Club, 8, Queen Anne's-gate, S.W., and Kent-lodge, Sidcup, Kent.
- Crowley, William Henry, Oakbourne, 8, Oakholme-road, Sheffield.
- Deane, Col. H. Bargrave, 5, Eaton-place, S.W.
- Dove, John, 1A, Cannon-street, E.C.
- Duthy, John Walter Brand, Cronberg, Arterberry-road, Wimbledon.
- Dvorkovitz, Paul, 6, Willow-bridge-road, Canonbury, N.
- Evans, Sir David, Alderman, K.C.M.G., Ewell, Surrey.
- Eyton, Thomas Ruxton Slaney, Walford - hall, Shrewsbury.
- Faviell, Charles V., Westcombe, Westcombe-park-road, Blackheath, S.E.
- Fleet, Charles, 8, Park-crescent, Brighton.
- Gilbertson, Edward, Garth - house, Torrs - park, Ilfracombe.
- Greenwood, Captain William Nelson, Glasson Dock, Lancaster.
- Harvey, Thomas Morgan, Portland-house, Basinghall-street, E.C.
- Henwood, Paul, College-hill-chambers, E.C.
- Henty, Walter, 32, Eaton-square, S.W.
- Hill, Seymour McCalmont, M.A., 10, King's Bench-walk, E.C., and 24, Norfolk-square, Hyde-park, W.
- Hutchinson, Lieut.-Colonel William Lacy, R.A., 11, Phillimore-terrace, Kensington, W.
- James, Henry, Holly Bowers, Chislehurst, Kent.
- Jancke, Fritz, 8, Linden-road, West-green, South Tottenham.
- Jenkinson, Thomas, 21, Mincing-lane, E.C.
- Jephson, Captain Sir Alfred, R.N., 5, Seville-street, Lowndes-square, S.W.
- Jones, D. Pugh, Llanelly, South Wales.
- Keiller, William, Fernwood, Wimbledon - park, Surrey.
- Key, William, Central Chambers, 109, Hope-street, Glasgow.
- Lavers, Nathaniel Wood, The Woodlands, Long Ditton, Surrey.
- Leale, Rev. Thomas Henry, 4, St. Agnes-place, Kennington-park, S.E.
- Leon, Auguste, 21, Tregunter-road, South Kensington, S.W.
- Liddiard, James Edward, Rosemont, North Finchley N.
- McConnel, W. H., Marsh-green, Ashover, Chesterfield.
- Middleton, Professor J. H., M.A., South Kensington Museum, S.W.
- Musgrave, Alfred Simson Joseph, 3, Clifton-villas, Bradford.
- Nichols, H., 4, Argyll-place, Regent-street, W.
- Nicholson, Robert Beattie, 115, High - street, Lowestoft.
- Oates, Charles Parkinson, 43, St. George's-square, S.W.
- Ogilvy, John Francis, 21, The Grove, Boltons, S.W., and Sun-court, 67, Cornhill, E.C.
- Pennant, Philip Pennant, Nantlys, St. Asaph.
- Potter, Henry Arthur, 105, Fordwych-road, West Hampstead, N.W.
- Prendergast, Major - General Guy Annesley, 6, Bramham-gardens, S.W.
- Price, Frederick Wakefield, 49, Guilford-street, Russell-square, W.C.
- Quirk, William Henry, 9, Gracechurch-street, E.C., and Altyn-house, Sutton, Surrey.
- Richards, Henry Charles, 2, Mitre-court-buildings, Temple, E.C.
- Robinson, Richard Atkinson, 195, Brompton-road, S.W.
- Sadasewjee, Hurrychund, Great Indian Peninsula Railway, Bombay.
- Sharp, John Edmund, 176, Belsize-road, N.W.
- Shearer, Arthur, 173, Ham-park-road, Forest-gate, E.
- Sifton, Thomas Elgood, 53, Shepherd's-bush-green, W.
- Simpson, Augustus John, Haverhill, Suffolk.
- Slater, Sydney Herbert, 126, Highbury New-park, N.
- Slattery, Henry Francis, 13, Old Broad-street, E.C.
- Spring, Francis Joseph Edward, Acting Consulting Engineer to Government of Bombay Railways, Bombay, and care of W. Watson and Co., 27, Leadenhall-street, E.C.
- Stevens, William, Technical Institute, Ealing, W.
- Stott, William, 66, Adelaide-road, N.W.
- Straight, Sir Douglas, 125, Victoria-street, S.W.
- Thornton, Henry, 5, George-street, Euston-road, N.W.
- Usher, Richard, Bodicote, Banbury, Oxon.
- Veit, Charles F., 28, Bartlett's-buildings, Holborn-circus, E.C.
- Wade, Joseph Armytage, Hornsea, near Hull.
- Weeks, John Wills, 276, Westminster-road, Liverpool.
- Wheeldon, James, Albert terrace, Brinnington, Stockport, and Carrington-road Works, Stockport.
- White, Francis Alfred, Uplands, Foyle-road, Blackheath, S.E.

White, Henry Osborne, 35, North-bank, Regent's-park, N.W.
 Williams, William Clement, 13, Akedo-road, Halifax, Yorks.
 Wilson, Sir Alexander, Red-house, Dartmouth-grove, Blackheath, S.E.
 Wright, Alfred, Bessingby-hall, Bridlington, York-shire.

The CHAIRMAN delivered the following

ADDRESS.

For the fourth time I have to address the members of this Society as Chairman of Council. I feel the gravity of the task imposed on me to-night more than usually heavy. As I said on the first occasion, when I had the honour of filling this place, if I possessed an intimate knowledge of any scientific subject upon which I could instruct or guide the members of the Society I should feel greater confidence in discharging the duties of the important position that I have the honour to hold. But, in default of this qualification, I will ask you to permit me to occupy your attention this evening by directing your minds to the special work of the Society during the last Session, and expressing good hope for the future work of the Society in the Sessions to come.

The past year has been, in many senses, eventful. The work of the Society of Arts is worthy of detailed notice: its position and prospects in the future merit careful examination, with a view to possible modification of some branches and sections, necessitated by the changing times, and the fact that other bodies and organisations are now working in fields which, during portions of the life of the Society, have been left to the efforts of the Society alone. In addition, there is the important work that has been performed by the Council of the Society in connection with the Exhibition at Chicago, upon which you would expect, and are entitled to receive, the best information at my disposal. To treat all these subjects adequately would make a far larger draft on your time and patience than I dare attempt; you will, at any rate, understand that the brevity of my remarks upon some points is not occasioned by any want of interest in or failure to appreciate the importance of the work of the Society in every particular, but is due to the fact that I have been compelled to make a selection of those topics which seemed to demand a more lengthened notice.

I regret to say that the ranks of the Society have during the past year been diminished

by the death of an unusual number of distinguished men. The following names occur to me:—Edward Graves, W. Mattieu Williams, Sir Richard Owen, Dr. Soubeiran, William Hudson, H. M. Backler, Alfred Carpmael, Colonel Grover, Sir George Findlay, Vicat Cole, R.A., the Earl of Derby, K.G., Sir James Anderson, W. T. Glover, Sir William Mackinnon, Sir Theophilus Shepstone, H. C. Saunders, Q.C., Lord Alfred Churchill, Thomas Hawksley. To the public life and past services of all of these it is not possible to refer, but there are some which imperatively demand some mention from me. The pre-eminent services of Sir Richard Owen, the distinguished naturalist, who died at the ripe age of 89, are well known to this nation. He was a member of the Society from the year 1855, and in connection with the great exhibition of 1851 delivered a very remarkable paper on the subject of the raw materials from the animal kingdom. In the year 1866, in applying to Mr. Ayrton, the First Commissioner of Works, he pointed out the necessity and the public demand for a fitting Museum of Natural History. The present building at South Kensington, already covering upwards of seven acres, is the best answer to those who opposed Sir Richard Owen's demand for a space of even two and a half acres. Another of our members, Mr. Thos. Hawksley, who was also spared to us to the ripe age of 86, and who, having been an elected member in 1868, filled the office of Vice-President from 1888 to 1892, was a pioneer in improved sanitation, effective drainage, constant water supply, and the manufacture and purification of gas. The position of Mr. Hawksley in connection with the Institutions of Civil and Mechanical Engineers and the Gas Institute have been recognised elsewhere; it is, however, only fitting that, before the members of the Society in which he took so kindly an interest, some notice of his memory should be taken. In the death of Mr. Alfred Carpmael, unfortunately, at the early age of 58, this Society has, indeed, sustained a very severe loss. Besides serving as member of the Council and Vice-President, Mr. Carpmael had acted for many years as honorary solicitor, and his firm were closely connected with the British Section of the Exposition Universelle at Paris, in 1889, and he had a wide experience in all matters connected with exhibitions. With an intimate knowledge of the Patent-laws of his country and of many other nations, with a keen interest in the

scientific questions of the day, Mr. Carpmael's advice to the Council of this Society was invaluable, added to which we cannot but remember the unsparing unselfishness with which he was willing to give his time to any question of importance, and the firm friendships which he had formed with many members of this Society. His place is one which it is very hard indeed to fill. Time permits me to refer in detail to but one other name, that of a gentleman who had been a member of this Society ever since the year 1862, had twice held office as Chairman of the Council, and served repeatedly as Vice-President and member of the Council. I refer to Lord Alfred Churchill. He was a constant attendant at meetings of the Society, and frequently presided. He received a special vote of thanks on the occasion of his last retiring from the office of Chairman, and was untiring in his endeavours, by every means in his power, to promote the cause of science training and sanitary reform. I am satisfied that though I have detained you a few moments with this branch of my subject, I have only performed, to the memory of those to whom the Society owes so much, a duty which you would be the last to wish should have been omitted.

I desired, in framing the address which I have prepared, to call your attention in the first instance, to the special work of the Council of the Society of Arts in connection with the Chicago Exhibition. I have more than one reason for adopting that course. The duty which has been imposed upon us during the last two years—by no means, I can assure you, a light task, or one free from anxiety—will be practically completed by the end of the current year, and the Council of this Society must revert to the duties which belong to it in the promotion of scientific research, the diffusion of useful knowledge, and the encouragement of the liberal arts, and, therefore, as I intend, before I conclude, to make as earnest an appeal as I can to you to lend your aid to maintain the high reputation which, for upwards of 100 years, your predecessors in the ranks of the Society have maintained it is, perhaps, as well that I should dispose, in the first instance, of that most interesting subject, viz., the work of the Society in connection with the Chicago Exhibition, the results, so far as it is necessary or expedient to bring them before you, and the lessons which we have been taught by that Exhibition.

This is a very large subject, and after two

years of active work in connection with it, and after having visited the Exhibition myself, and endeavoured, to the best of my ability, to represent the British Commission there, many reflections arise at once in one's mind. It was certainly, from the point of view of ordinary Exhibitions, absolutely unique. The world has never seen anything of the kind before, anything upon the same scale either of magnitude or magnificence. I doubt whether the occasion will ever come for such a display being seen again. It is difficult to imagine that such an Exhibition could take place in any other country than the United States, and certainly I doubt whether any other nation would have at its command the variety of resources which tended to make that great Exhibition such a success.

Let me, for a few moments, deal with this view of the matter. In other exhibitions which have preceded the great Columbian Exposition of 1893, we have had foreign nations which have sent to the exhibition which was being held their manufactures, their productions of art, their machinery, their inventions, which have been collected together and housed in certain portions of large buildings erected for the purpose, and with the sole object of making the best possible display of those interesting objects which had been contributed by the various nations. This Exposition struck me, and struck many with whom I conversed, at once from a different point of view. It was not only a gathering of the products of the genius and the inventions of mankind, it was a great gathering of peoples, and a gathering of peoples in a way which introduced, for the first time in the history of exhibitions, a novel feature and one of great interest; and from the point of view of drawing together the nations of the world into one family, it was of paramount importance.

You, of course, know that the great republic of the West consists of upwards of forty States, each having certain rights in themselves, but bound together by their allegiance to the great Federation. In this Exhibition a very large number of those States was represented by what may be not unfairly called an independent habitation, and the consequence was that to each of those houses which represented the interests of the various States the inhabitants of these States were drawn together, and were taught to regard their particular house and their particular exhibits as belonging, so to speak, to themselves. Nor did it stop with

the State houses themselves. Many of the foreign nations, including, I am proud to say, our own nation and some of our dependencies, were represented by separate houses which were typical in many respects of the character of nations whose name they bore, and at the same time served as a centre and gathering ground for the subjects or citizens of those various nations.

Those who have experience in exhibitions will agree with me that these features to which I have referred were absolutely and entirely new, and gave a character to this Exhibition of great practical value, and led, to a large extent, to the success which attended this Exposition.

I am not able to-night wholly to represent to you pictorially every feature which I have attempted to describe, but, by the great kindness of a member of the Council, to whom we owe much in connection with this matter—Mr. James Dredge—I am able to show you certain views of the Exhibition which I am sure will interest you, when I tell you that they are not fancy sketches or ideal pictures, but they are every one of them taken by a hand camera, and are views of the Exhibition as it was going on.

Before I show you the series of views which Mr. Dredge has put at our disposal, I desire to notice, and to enable you to appreciate, the public spirit and the one idea which ran through the whole of the foundation and carrying out of this Exhibition on behalf of the Executive of Chicago. In other exhibitions you have had large spaces of ground occupied, and buildings erected, with a certain attempt at an harmonious architectural whole, and those buildings arranged, to a certain extent, with reference to each other; but the point of departure which signalled the Chicago Exhibition was, in my opinion, absolutely unique. They were not content with effective buildings; they were not content with ample space; they were not content with designing for each particular section the structure which they thought would be best suited to its requirements: they started with the idea that they were aiming at one grand whole; and I mention this as a lesson to some of you, the younger members of this Society, who may have to do with these matters in future. They created a magnificent construction of lakes, canals, and gardens connected by watercourses, some of which I shall be able to show you, and round which they placed their buildings, all arranged and designed with a view to producing a grand dis-

play, both of architecture and of exhibition buildings, which would not strike the spectator or the visitor merely by the consideration that each building was fitted for its purpose, but that they were all designed in order to produce the effect of a grand arrangement of magnificent structures, each in its proper place, and well fitted for the purpose for which each was designed. How far they succeeded in that idea you will be able to judge in a few minutes; and, inasmuch as I am anxious to put this before you fully, and, at the same time, not at too great length, I will now ask Mr. Davenport to put the views upon the screen.

1. This is a view of the Court of Honour of the Exhibition, taken from the top of the Administration Building. It is difficult adequately to describe the general effect of the view of this court, when seen under favourable circumstances by daylight, or when illuminated at night. On the further side of the peristyle or colonnade is Lake Michigan, the waters of which fed the numerous lakes and canals in the Exhibition grounds. The whole of the structure was executed in white plaster of Paris, or some similar material, which gave it almost the appearance of white marble, and every niche was appropriately filled with statues, which can be seen in the photograph above the columns, giving the appearance of thoroughly permanent work. On the right is the Agricultural Building, and on the left the building of Manufactures and Industrial and Liberal Arts. This view will enable you to appreciate at once the distinctive feature of this great Exhibition, namely, that, as I have said, it was not merely a collection of buildings arranged or constructed one after another on a vacant piece of land, but that the whole park was laid out so as to form a series of lakes of varying size, communicating with one another by canals, and each building had an appropriate and distinctive site, with one, two, and sometimes three water frontages, leaving space for large quays or promenades, each connected by wide bridges, accommodating thousands of people, without any inconvenient crowding or interference with locomotion. At night, this court was illuminated by thousands of electric lights, producing an effect upon the white buildings which may, without exaggeration, be said to baffle description.

2. What I have just explained to you, as to the situation, and, as the Americans call it, location of the building, is very well exemplified in the view now thrown upon the screen. This is taken from the south end of one of the

canals. In the centre of the view you will see the canal crossed by three bridges, all of which are shown in the view. In the far distance is the State Building of Illinois, distant from the place at which the camera must have been situated three-quarters of a mile or more. On the right hand is the Agricultural Building, on the left, the east end of the Machinery Hall. Between the first and second bridges is the Court of Honour, of which I have just shown you the view, on the other side of which you will see, upon the right, a view of the Manufactures Building, on the left the Electricity Building. The monument in the immediate foreground was commemorative of the discovery of America by Columbus. It will be noticed that all the quays are laid out and finished, as though they were intended to be permanent; and, in fact, speaking for the park, apart from the Exhibition buildings themselves, it is sincerely to be hoped that the gardens, lakes, quays, and bridges will be preserved as a permanent memorial of this magnificent Exhibition, adapted, as it would be, for many useful purposes in future years.

The next series of views will show you some of those buildings more in detail. I can pass them over rapidly with a few words of explanation, showing their special adaptation.

3. This shows the west side of the Manufactures Building, facing on to the canal. You will again notice the building of the State of Illinois in the distance, this view being taken from the other side of the Court of Honour. On the canal you will observe one of the electric launches, of which there were a large number plying at frequent intervals on the various piers, and lakes, and the canals, and forming a most convenient and agreeable mode of locomotion between the various parts of the Exhibition.

4. This shows you, on the left, the other corner of the Manufactures Building, facing on to the same canal, the corner of the Agricultural Building, and a small portion of the Manufactures Hall, with a monument in memory of Columbus in the distance.

5. This shows the south end of the Manufactures Building, facing on the Court of Honour, and gives a very good idea of the admirable way in which the building was constructed from the point of view of light and access. On the top will be seen the promenade, which extended the whole way round the roof of the Manufactures Building, and from which a grand view of the Exhibition and

the surrounding country could be obtained. Lifts ran continuously from the floor of the building to the roof. The statues to which I have made reference in the first photograph on the screen, can be seen more plainly in the present view, and, accustomed as we are in England to see the niches even of permanent buildings remain for generations without any statues, one was greatly impressed by the thorough and complete manner in which the ornamentation of these buildings, although designed only to exist for a few months, had been perfected.

6. This view again gives you some idea of the extent to which the ornamentation and decoration of the buildings have been carried. You are looking at the south-east end of the peristyle. Immediately on the left of the picture is a statue of Liberty, facing west. This statue somewhat resembles in general appearance the great statue of Liberty presented to the United States nation by the French Republic, but must not, of course, be confounded with it, that statue being situated in New York. On the right is the reproduction of the convent of La Rabida, in which were gathered together a large number of relics of Columbus and the early discovery of America. On the extreme right is the north-east corner of the Agricultural Building.

7. The photograph now upon the screen is an excellent view, showing the middle of the peristyle, and the statues, which can now be clearly seen, and will convey to your mind that to which I have before referred—the extent to which the ornamentation of the building was perfected. Upon the top of the central arch is a *quadriga*, very similar, if not a reproduction of that in Paris. Underneath the central arch there was a passage-way to Lake Michigan, through which steam launches were able to pass.

8. This view completes the representation of the Court of Honour, showing the east front of the Administration Building, which stood at the head of the Court of Honour, the McMonnies Fountain, and the north side of the Machinery Hall. The roof and general outline of the Administration Building was illuminated at night by lines of incandescent lamps, and those who remember the beautiful effect of similar illuminations at the Inventions Exhibition, in 1885, will readily appreciate how magnificent those illuminations were when applied to a building on so gigantic a scale.

9. The view now on the screen shows a part of the grounds away from any of the lakes and

canals. The building at the end will be readily recognised as the Administration Building, of which the north side is represented, the formation and construction of the dome, and colonnade on the upper storey, being particularly effective. On the left is seen the west side of the Electricity Building, and on the right the east side of the Mines Building.

10. This view shows the west and part of the north sides of the Machinery Hall. As I have already called attention to those buildings, I need not do more than point out the variety of the architecture which distinguishes this and many of the other buildings, whilst, at the same time, harmonising with its surroundings.

11. This photograph gives a view of the Grand Canal, looking south, showing one of the landing stages for the electric launches in the immediate foreground.

12. The view now placed upon the screen shows the northern face of the Agricultural Building.

13. Next come details of the central portion of the same building, showing the statue of Diana on the top of the central dome.

14. This view shows an entirely different portion of the grounds. This part of the lake or lagoon is situated to the west of that shown in the previous views. On the left will be seen the small portion only of an island, which was arranged with great taste with flowering shrubs. On the left will be seen the north-west corner of the Mines Building, and the great building shown in the view is the Transportation Building, in which were arranged specimens of every mode of transportation, from the earliest times down to the present. This building, unlike the others, was very highly coloured, and was, in my opinion, the least effective of any of the great buildings of the Fair, while, at the same time, it showed signs of originality of design. It will be observed that the whole face of the building fronts upon one of the lakes, to which I have already referred.

15. This view shows the central doorway, or entrance, which was perhaps the most effective part of the whole construction.

16. This slide shows the east face of the Electricity Building, and it conveys a very good idea of its general appearance.

17. In this view is seen the general elevation of the Horticultural Building, the corner of the Transportation Building being seen upon the left. This will show you

how each building was designed with special reference to the objects which were intended to be exhibited, and may, I think, be fairly regarded as a very successful attempt to vary the architecture while bearing in mind the general effect aimed at in connection with the arrangement of all the buildings.

18. The next view shows the main entrances to the Horticultural Building, and gives again a very good illustration of the care with which the details of the work have been designed and executed.

19. The view now on the screen shows a building, excellent in design and in many ways very original, which was devoted to woman's work, called the Woman's Building. At either end it will be observed that portions of the roof have been utilised to afford additional accommodation; they were used at one, if not at both ends as resting-places and places for refreshments, and certainly, as far as I could judge, proved exceedingly popular.

20. This view shows one of the most characteristic buildings in the whole Exhibition; it is a view of the south side of the Fisheries Building. It will be noted that the style of architecture is entirely different from that of the other buildings, while, at the same time, extremely appropriate, having regard to the very varied character of the exhibits that such a building must contain, from boats and ships to cases of preserves and modelled fish, and, in addition, a very large aquarium. I think it will be agreed that those who were responsible for the design were deserving of very high commendation. Certainly no building in its way attracted more attention or elicited more general approval.

21. This is another view of the same building, showing the details of the work.

22. This very remarkable building, although perhaps not so generally admired as many of those of which views have been shown you, is the Government Building of the United States, in which were gathered together a large number of the exhibits lent by the Federal Government and various Departments of the State. The design of the windows admitting light into the dome was original, but perhaps not very successful. The general effect of the building, as it was surrounded by others of different character, was better than perhaps may be gathered from the view of the building alone in the photograph.

25. This is a photograph of the imitation "line-o'-battle" ship, which was situated

close to Victoria House. It will, of course, be understood that, inasmuch as it is in the water of Lake Michigan, although to the eye it appears to be a real man-o'-war, it was, in fact, a temporary construction, but so perfectly finished, and with every detail so accurately represented, as to mislead anyone not acquainted with the fact that it was an imitation.

24. Passing away to an entirely different part of the grounds, I now show you a view of the Fine Arts Buildings, in my opinion one of the most perfect, and admirably adapted for the purposes for which it was intended. It might, indeed, form a design or suggestion for a permanent art gallery. I need scarcely again call attention to the complete way in which the ornamentation of the building was carried out, so singularly in keeping with the purposes to which it was appropriated.

25. This view shows the façade of the great Central Railway Station, which, contrary to every expectation of the originators of the Exhibition, proved the least useful building of all those which were erected. This is a striking example of how difficult it is to foresee beforehand what may be the success of any particular plan of arrangement. It was supposed that this railway station would form the principal means of access to the Exhibition, whereas, as a matter of fact, it was scarcely used at all, the vast numbers of persons attending the Fair finding it necessary to remain in Chicago, and to come out by the local train service.

26. We now come to a very interesting and characteristic series of views, which I must pass over hurriedly, but which do deserve passing comment. The distinctive features of this Exhibition were the homes established by a large number of the States to represent the various States of the Union, 42 out of 44 States were represented, many of them by buildings which were in themselves worthy of being a separate exhibition. The first shown is the magnificent building of the State of Illinois, in which Chicago is situated, which formed a prominent feature in the grounds, as you will have remarked from its figuring in several of the previous views.

27. This view shows the house of the State of Pennsylvania, with the building of California on the left. It will be well to observe in passing, the characteristic varieties of the architecture in the different cases. In many instances they were taken from some typical building connected with the history of the State which they represented.

28. This is a representation of a building of the State of New York, indicative, as its appearance shows, of the great wealth and prosperity of that State.

29. The view now on the screen shows a portion of the very interesting house erected by the State of California. It was practically a reproduction of one of the old haciendas erected by the first settlers in the State, and which are so familiar to those who have travelled or resided there. The greater part of these buildings were the result of the energy and enterprise of the Franciscan and other religious bodies who played so large a part in the civilisation of California.

30. This is a view of the State house of West Virginia. It was, I believe, a reproduction of one of the oldest houses in the State.

31. The view now on the screen shows the house erected by the State of Nebraska.

32. This view shows a very picturesque house devoted to the State of Iowa; its chief feature, however, was the internal decoration, which was formed to a large extent, if not entirely, of the cereal and vegetable products of that State, arranged with the greatest taste, and being a remarkable indication of the agricultural prosperity of Iowa.

35. The view now on the screen shows one of the restaurants, of which there were so many scattered about the grounds.

34 and 35. The next two views show the French house and the magnificent pavilion of the Republic of Brazil, which, from its situation and original design, attracted a great deal of attention.

36. This slide shows the building erected by Krupp, of Essen, the largest individual exhibitor in the whole Exhibition, and containing exhibits of ordinance valued at £300,000.

37. This view shows the Midway Plaisance, which was a sort of annex to the Fair, containing a number of independent exhibits, with the Ferris wheel in an unfinished condition in the distance.

38. The last view shows the shore of Lake Michigan, with the German, Spanish, and Canadian houses on the right, and the Victoria house in the distance. The view of the Victoria house does not do it justice.

I desire now to deal specially with the work of the Royal Commission in connection with this Exhibition, and it will be well to glance for a moment at some of the leading difficulties with which the Commission found itself confronted. The great length of transit, with the

heavy expense attendant on the transport and care of large and important exhibits, was a difficulty which was especially felt in connection with this Exhibition. In addition, the unsettled condition of trade, due to the tariff agitation, and the keen feeling on the part of the great majority of manufacturers as to the effect that the imposition of the tariff had had, and would continue to have, upon their trade, rendered a very large number of persons who might otherwise have exhibited very unwilling to incur the expense and risk. The fact that the British Government were not in a position to undertake any share of the great expense involved beyond the grant made to the Royal Commission, whereas some foreign countries were spending much larger sums on the exhibits themselves, naturally had a prejudicial effect. I took great pains when in America to ascertain whether similar causes had affected other countries and colonies, and those who have examined the Exhibition in detail will, I am sure, agree with me that they undoubtedly did. In the case of Canada, I learnt from the leading representatives of the various industries in that country that, notwithstanding the transit was comparatively short, and the risks and expenditure, both of time and money, far less than would of necessity have to be incurred in connection with the exhibits from Great Britain and Ireland, and other parts of the world, still the manufacturers and leading commercial men were unwilling to take part in the Exhibition. This is neither the time nor the place to consider whether the view taken by great manufacturing firms in England, Scotland, Canada, and other countries foreign to America was, or was not correct, but in considering the results of the work of the Royal Commission these causes must be kept in view. To any one interested in any special branch, say, for instance, machinery, electricity, mining, or agricultural implements, and who devoted his attention solely or principally to that particular branch, the number of exhibits shown from Great Britain and Ireland was undoubtedly disappointing. At the same time, I wish to state most distinctly, and I hope it will go forth to the public, and I do so as an act of justice to those who went to great expense in sending exhibits to Chicago, that speaking of them individually (and I visited and inspected every British exhibit during my stay there) from the point of view of merit, those exhibits well maintained the reputation of this country. Permit me to say

a word also with regard to the collective exhibit, by which I mean the exhibit under the British flag. It is impossible to speak in too high terms of the marvellous productions of Canada and New South Wales. Old England and Great Britain may be proud of two such children. In the Agricultural Department, in the Mines Department, and in many other sections, both those colonies were remarkable, and were we to judge of the success of Canada by the awards alone—though I cannot state the exact number as the complete list is not yet issued—it would be almost unique. Taken as a whole, and collectively, the exhibits from Great Britain and Ireland, Canada, New South Wales, the Cape of Good Hope, Ceylon, Jamaica, and Trinidad, the combined exhibit under the British flag was, in my opinion, equal to that shown by any other nation. I desire to add, that even in the sections devoted to the United States there were not a few instances of the absence of leading manufacturers and exhibits.

I would, in the first place, refer to the British exhibit in the Fine Arts Gallery, painting, sculpture, architecture, and decoration. Everyone who saw the collections of pictures and drawings will be of opinion that it is difficult to employ too high words of commendation. The success of this exhibit was very largely due to the unsparing efforts of Sir Frederick Leighton and the members of the Fine Art Committee associated with him, and to the secretary, Mr. Beck. It attracted universal admiration from the representatives of all nations, and both for variety, accurate and careful work, and artistic excellence, lost nothing by comparison with the exhibits of other nations.

I will next refer to the exhibits in the section devoted to manufactures and the liberal arts. Here the number of our exhibitors was considerable, and in this, as in every other section, even those in which the numbers were comparatively small, the high merit, both as to finish and workmanship, of the British manufactures attracted the highest praise. I should convey a false impression if I were to attempt to select names, but I may be permitted to mention the group of exhibitors in ceramics and mosaics in which Brown, Westhead, and Moore, of the Staffordshire Potteries; the Coalport China Company, of Shropshire; Messrs. Daniel, who represented Minton's, Wedgwood's, and other manufactures; Messrs. Doulton and Company, of London, whose magnificent exhibit elicited

universal admiration ; and the Royal Worcester Porcelain Company, of Worcester, combined to make a representation of British ceramic art which, as a collective exhibit, surpassed anything of the kind shown by any other nation. I might also refer to the admirable exhibit of Messrs. Gibson and Company, of Belfast, and Mr. Edwin Johnson, of Dublin, and the Goldsmiths' and Silversmiths' Company of Regent-street, in gold and silver ware, and to the group appropriated to yarns and woven goods, of cotton, woollen, and vegetable fibres, and woollen goods, in which very high-class goods were displayed. Whatever may be said of the number of the exhibits, their quality cannot be gainsaid.

In the Machinery Hall the number of British exhibitors was comparatively limited, but the exhibit of Messrs. Platt Bros., of Oldham, the very complete plant of Messrs. Baker and Sons, of the City-road, the engines of Messrs. Willans and Messrs. Galloway, and the exhibit of Messrs. Wright, of Dudley, together with many others, were certainly most popular and very highly commended.

In the Transportation Department, the exhibits of the London and North-Western Railway and the Great Western Railway Companies were magnificent ; that of the London and North-Western Railway contrasting most favourably with the most recent developments upon American railways. In the group assigned to vessels for marine, lake, and river transportation the class was extremely good. The Thames Ironworks, Messrs. Laird Bros., the Peninsular and Oriental, the Fairfield Shipbuilding Company, Messrs. Denny and Dunbarton, the Cunard Steamship Company, Messrs. James and George Thompson, and Messrs. Thomas Cooke and Sons having admirable exhibits. Nor must I forget to mention the exhibit of the White Star Line, for which a special building was erected in the grounds. In the same building was the very fine exhibit of Messrs. Armstrong, Mitchell and Company, of Elswick, and outside the Maxim and Nordenfeldt Gun Company.

In the department of Agriculture including Forestry, there were seventy-one exhibits, and I was surprised in going through them to find how popular they were and how much interest they excited. There were a great many names, all of whom ought to be mentioned, but I should like to refer to the very fine exhibits of Messrs. Crosse and Blackwell, of Jubal Webb, of the wool growers of Victoria, to a very large collection of Scotch and Irish whiskies, and

to the statistical information as to the experiments of Messrs. Lawes and Gilbert, which attracted a very great deal of interest. There was also a very large model of the Brookfield Stud Farm of Mr. Burdett Coutts, which I found was extremely popular.

In mines and mining there was a most admirable collection of economic minerals by Mr. Brough, of economic metallurgy by Dr. Ball, and a very fine exhibit by Messrs. Johnson and Matthey, which were spoken of by the scientific men of the United States in terms of the highest praise, and there were others of which a mere repetition of the names would not convey any distinct idea.

In electricity we were certainly wanting. I always regretted, although I can well understand it, that our electrical firms, whose work I believe will bear comparison with that of any other nation in the world, should not have exhibited ; but I think it only right to pay a public tribute to the spirit and the loyalty which prompted a member of our Council, Mr. Preece, to send over such an excellent historic exhibit of telegraphic apparatus, which taught, probably, our United States friends more of the history of telegraphy, if they took the pains to go through it, than anything else ever brought together. I feel that such an acknowledgment ought to be made to a public department. I ought also to mention in connection with that, the exhibit of the Ordnance Survey department at Southampton.

In bringing my remarks to a conclusion, I must not forget the very important and useful work of the Women's Section. I do not mean to use exaggerated terms of praise with regard to all the exhibits ; possibly some of them might have been weeded out, but, taken as a whole, the exhibit was creditable to the world, and to this nation, and I unhesitatingly say that the British women were not behind in that Exhibition. We owe a considerable debt to Mrs. Roberts Austen and Mrs. Bedford Fenwick for the part they both took in organising that part of our Section ; and the Ambulance and Nursing Exhibit of the British Women's Section was admitted by everyone to be far in advance of anything shown by any other country.

I desire also to say a word or two with regard to the work of our staff. I am in a position to state for myself, having interviewed all the representatives of the executive staff of the Exhibition, that throughout the whole of this Exhibition there was, practic-

ally, no friction whatever between the British staff and the Executive of the United States Exhibition, and that the relations were most harmonious. Questions of course arose, but they were settled from time to time by the tact and discretion of our esteemed representative, Sir Henry Trueman Wood, and the very efficient staff that were selected, partly by him, and partly by the Royal Commission. It is, I think, worthy of note, that the British Section was the only one which was ready at the date of opening. Its catalogue—perhaps next to that of New South Wales the best one published—was the only one which was ready at the opening; and it is the fact that, speaking of preparation, although their exhibits were admirable, it was several weeks before those of many other foreign countries were in anything like the state of preparation ours were in at the date of the opening. There is no honour due to the Commission for it, I admit, but great credit ought to be given to the staff, who so loyally carried out their wishes.

I must say a word or two about Victoria House; its designs, the work of our Honorary Architect, Colonel Edis, were excellent, the arrangement and proportions of the rooms being admirable. The ceilings and panelled fittings of the house, the staircase, chimney pieces, and, in fact, all the internal fittings, were constructed by Messrs. Johnstone and Norman, from Colonel Edis's designs. The furniture was also supplied by Messrs. Johnstone and Norman, and was singularly beautiful and appropriate. Victoria House, which was the only permanent structure erected by any nation or state, was visited by many thousands of persons during the Exhibition, and was, to my own knowledge, universally admired.

I apologise for the length of time at which I have detained you this evening, but I think that the epoch which we have passed through is one which is deserving of special notice, and which, I hope, you will consider has not been brought before you at a length which is inconsistent with its importance, or with the interest which you, as members of the Society, take in it.

Let me say a few words, if you will permit me, with regard to the future work of our Society. We come back from the dreams of Chicago, from the pleasure of the visit we have spent there, to the everyday work of the Society. What have we to do? We can look back on

years of useful work performed by our predecessors in our various positions, and we have their example to prompt us to fresh efforts, which, I confidently hope, will not fall short of those which have preceded them. We must remember that, with the changing times, as I said in opening, the work of this Society must change. We welcome the successful launching of that fresh undertaking, the Imperial Institute, which, at the other end of London, is attracting so much attention. An object of the greatest interest to our President, it is, at the same time, by no means other than an object of interest to many of our members. We must expect that, in connection with our Colonial and Indian Sections, the Imperial Institute will have some effect; and not only that it will divert the interest of some of those who have supported the work of those Sections in the Society, but that it is entitled to claim their efforts and services. But you need not be afraid that there will be no object to enlist and encourage the activities of the members of the Society. Day by day, I might almost say hour by hour, the necessity for technical education, for technical information, is becoming more and more pressing upon us. In all parts of the country technical institutes are being established, and there are scarcely any of those societies which do not desire to be associated with the Society of Arts. We have very bright prospects before us. The papers, of which I have under my hand a list of those likely to be read, seem to me to be by no means inferior to those which have been read in previous sessions; and if the members of the Society—some of them, I know, are very hard worked, others having more leisure—will only recognise the duty that they owe to their fellow creatures and to mankind, and that is—not to keep their knowledge to themselves; not to keep their experience to themselves; not to keep the lessons of their life to themselves, but to give accurate information to their fellow workers as to what has been the result of their own researches and experiments, it is not easy to exaggerate the good which this Society may do.

I thank you for the honour, which has been bestowed on me four times, of delivering an address to you. I only desire that my work on the Council, helped, as I have been, by many distinguished men, who have worked for it far longer than I have, may be carried on as long as I am its chairman, with the same zeal and efficiency as it has been in the past; and I appeal to every member of the Society to do

his or her utmost to promote the cause of knowledge, and, by promoting the cause of knowledge—by diffusing useful knowledge—to draw closer together, in bonds of friendship and union, the great family of mankind.

I have now to present to the recipients the Society's Silver Medals awarded during the past Session.

At the Ordinary Meetings :—

To JAMES DOUGLAS, for his paper on "The Copper Resources of the United States."

I rejoice to think that, not for the first time, the Society is able to show its appreciation of the valuable services rendered by a citizen of the United States, and that a medal has been awarded to Mr. James Douglas for his valuable paper on the copper resources of that country. Mr. Douglas possesses an intimate knowledge of the subject as one of the largest producers of copper in America, and it is not too much to say that the information which he placed at the disposal of the Society was a most valuable contribution to the knowledge of all those who are connected with the production of that important metal.

To WILLIAM KEY, for his paper on "The Purification of the Air Supply to Public Buildings and Dwellings."

In awarding a medal to Mr. William Key for his paper on "The Purification of the Air Supply to Public Buildings and Dwellings," I would call attention to the fact that not only did the process adopted by him embody many points of novelty, but that testimony was given to its success on a large scale from the results of experience in the Victoria Hospital at Glasgow. The introduction of the electric light removing, to a certain extent, the ready means of ventilation in connection with sun-lights and gas illumination of large buildings, has rendered the problem not less difficult, and, in some respects, more complicated. Any practical information upon such a subject must be of value in promoting healthy dwellings.

To PROF. FRANK CLOWES, D.SC., for his paper on "The Detection and Estimation of small proportions of Inflammable Gas or Vapour in the Air."

It gives me great pleasure to present a medal to Prof. Clowes, doctor of science, for his extremely valuable paper on the "Contact of Inflammable Gas or Vapour in the Air." Everyone is acquainted with the important part which the safety lamp—which was fully described by Prof. Clowes—plays in the life of

our miners; and the interest excited amongst the assembled Inspectors of Mines, who were present at the reading of the paper, on the invitation of the Society, showed the very warm appreciation that was felt in connection with the valuable improvement described by him.

To THOMAS R. DALLMEYER, for his paper on "Tele-photography."

Mr. Dallmeyer's name will be remembered by many members of the Society in connection with a very useful paper, read by him some three Sessions ago, on the subject of photographic lenses. The valuable information contained in his paper on "Tele-photography," read during last Session, and the success attained by the instrument described by him, mark a fresh departure in the science of photography.

To GISEBERT KAPP, for his paper on "Some Economic Points in connection with Electric Supply."

Mr. Gisbert Kapp's name is well known; his course of Cantor Lectures on the "Electrical Transmission of Power" contains most valuable information; and his thorough practical knowledge of scientific matters in connection with electricity made his paper on "Some Economical Points in connection with Electricity supply," for which I have the honour now to present him with a medal, of great value.

To H. VAN DER WEYDE, for his paper on "The Pictorial Modification of Photographic Perspective."

I am very pleased to have the pleasure of presenting a medal to Mr. Van der Weyde for his paper on "The Pictorial Modification of Photographic Perspective," by the use of the photo-corrector of visual lenses, in portraiture and landscape. This development of photography was to me of especial interest. The undue prominence of certain portions of a picture due, to the use of ordinary lenses, has been for many years, in my opinion, one objection to photography. The system described by Mr. Van der Weyde goes a long way to remove this objection. In presenting this medal I at the same time desire to thank Mr. Van der Weyde for the admirable exhibit made by him at the Chicago Exhibition, which, to my knowledge, attracted no small amount of attention.

In the Indian Section :—

To HERBERT THIRKELL WHITE, I.C.S., C.I.E., for his paper on "Upper Burma under British Rule."

In the Indian Section I have the pleasure of awarding medals to three gentlemen. The first of them to Mr. Herbert Thirkell White, C.I.E., for his paper on "Upper Burma under British Rule." Ever since the year 1878, with but brief intervals, Mr. White has been personally connected with Burma, in various positions, and those who had the pleasure of being present to hear his paper will remember that it produced a most admirable discussion which was subsequently continued in the pages of the *Journal* of the Society.

To J. BARR ROBERTSON, for his paper on "The Currency Problem."

Whether or not the arguments contained in Mr. J. Barr Robertson's paper will ultimately find favour, it is not for me to predict, but of this I am satisfied, that the information contained in the tables, so carefully prepared, which he exhibited, showing the relative positions of gold and silver during the last 25 years, was a most valuable contribution to the subject, and may well be studied by all, both bimetallists and monometallists.

To SIR JULAND DANVERS, K.C.S.I., for his paper on "Indian Manufactures: their present State and Prospects."

In presenting a medal to Sir Juland Danvers, I can but repeat the opinion formed at the time, namely, that both the paper, and the discussion thereon, deserved to be studied by all who are interested in our Indian Empire. From the year 1842 down to 1892—a period of 50 years—Sir Juland Danvers was officially connected with Indian affairs. In the year 1877 he read before this Society a most valuable paper on Indian railways, and again in 1889, on the progress of railways and trade in India. It is an honour to the Society that it should be in a position to again express its appreciation of Sir Juland Danvers' services.

In the Foreign and Colonial Section:—

To CECIL FANE, for his paper on "Newfoundland."

In the Foreign and Colonial Section, I have the pleasure of presenting three medals, the first to Mr. Cecil Fane, for his paper on "Newfoundland." Mr. Fane's personal connection with that colony and his previous experience at the Fisheries Exhibition of 1883, made his information respecting Newfoundland of especial value, and I can say, from personal knowledge, that there are few subjects which better merit the close attention

and careful study which Mr. Fane has undoubtedly bestowed upon them than the important fisheries which are to be found on the coasts of that island.

To H. A. MCPHERSON, for his paper on "The Philippine Islands."

Mr. McPherson's long connection with commercial industries made his paper of especial value, dealing, as he did, with fourteen years' experience in the islands themselves. I cannot help saying, from the information given to me, that Mr. McPherson has done much to promote British commercial interest in those parts of the world.

To W. B. PERCEVAL, Agent-General for New Zealand, for his paper on "Aspects of Federation from a Colonist's Point of View."

As many of you know, Mr. Perceval, a Member of the Legislative Assembly of New Zealand, and subsequently Agent-General for the Colony, is in a position to speak with high authority. I am sure you will agree with me, that the thanks of the Society are well earned in the paper which he contributed. The warm approval expressed by the Earl of Onslow, who presided on that occasion, was no small testimony to the value of Mr. Perceval's paper.

In the Applied Art Section:—

To HUGH STANNUS, F.R.I.B.A., for his paper on "The Theory of 'Storiation' in Art."

Mr. Stannus will be remembered as having delivered a very interesting course of Cantor Lectures on the "Decorative Treatment of Natural Foliage," which has, I think, not been without practical effect in the art of decoration. The paper, in respect of which this medal is awarded, contained many novel features, and is certainly well worthy of recognition by the Society.

To WILTON P. RIX, for his paper on "Pottery Glazes: their Classification and Decorative Value in Ceramic Design."

Those of us who have taken an interest in ceramic ware will readily recognise the value of investigation and research into the true causes of the artistic effect produced by glazing on china in ancient times. I am not aware that this subject had previously been examined from the point of view adopted by Mr. Rix's paper, and his connection with the great firm of Doulton and Co. is sufficient guarantee that the best sources of information would be at his disposal.

TO PROF. W. M. FLINDERS PETRIE, for his paper on "Primitive Art in Egypt."

Since the year 1881, Prof. Petrie has conducted several expeditions in Egypt, and been intimately acquainted with that country, the resources of which, in connection with archæology and artistic research, are well nigh inexhaustible. The paper referred to described some very remarkable discoveries made during one of the latter of those expeditions, and will repay a perusal by archæologists and those interested in Egyptian architecture.

Thanks have been voted to the following members of the Council:—

TO SIR EDWARD BRADDON, K.C.M.G., Agent-General for Tasmania, for his papers on "Australasia as a Field for Anglo-Indian Colonisation," and "Russia as a Field for Tourists."

TO JAMES DREDGE, for his paper on "The Chicago Exhibition, 1893."

SIR FREDERICK BRAMWELL, F.R.S., Bart, said it would be wrong to allow Sir Richard Webster to leave the chair without thanking him for his services to the Society, and especially for his work on behalf of the Society at the Chicago Exhibition. Those who had been unable to visit that Exhibition themselves must, of all others, thank him for the manner in which he had been as it were eyes to them, in bringing before them in such a vivid manner the main features of that great Exhibition, which appeared to have been pre-eminent among all others. For one thing they were all indebted to that Exhibition. It had been the cause of Sir Richard Webster occupying the chair of the Council for four years instead of two, as usual, and this had proved a great advantage to the Society. He was one of the most hard-worked of men with his legal and Parliamentary duties, and he had had not merely the ordinary labours of a Chairman of Council, but super-added to them and far exceeding them, the duties of Chairman of the Chicago Exhibition Commission. For a long while he had to be absent in Paris in connection with the best interests of this country, but he never left the Commission without guidance and council, and though absent in body he was present in mind and in spirit, and to him was due in great measure the success which had been attained.

SIR FREDERICK ABEL, Bart., F.R.S., in seconding the resolution, said it was a marvel to many who were hard-worked themselves, how Sir Richard managed to accomplish the work which fell upon him, as Chairman of the Council and of the Royal

Commission so successfully. They all thanked him most cordially, and hoped for further favours to come.

The vote of thanks having been passed,

SIR RICHARD WEBSTER thanked the members for the kindly reception they had given the gratifying speeches of his old friends, Sir F. Bramwell and Sir F. Abel. He had felt it a great honour to fill the position; the memory of it would never fade, and he could only hope that during the time he still remained in office he might be able to further the interests of the Society.

Miscellaneous.

MANUFACTURE OF EARTHENWARE TOYS IN THE PUNJAB.

It appears, from a recent report by the Secretary to the Financial Commissioner of the Punjab, that the sale of toys is chiefly carried on during Hindû festivals, and the maker prepares at a time only as many as he thinks will suffice to meet the demand at the fair at which they are to be sold. When a fair is approaching, he and all his family set to work, the women and children helping in kneading the clay, filling the moulds, arranging the oven, &c.; but when the fair is over, the toymaker returns to his regular employment, which is most frequently that of an ordinary potter. Toys are usually made in the figures of gods, men, and animals, and the manufacture is therefore entirely in the hands of Hindûs, for the Muhammadan is forbidden by his religion to make images. The largest number of toymakers are found at Lahore and Ambala, although toys are also made at Hissar, Delhi, Ludhiana, Mooltan, Amritsar, Ferozepore, and Muzaffargarh. The clay used is of the common varieties, the more tenacious kinds being preferred, but it is not made so soft as for pottery work. Toys are made on the wheel, by hand, or in clay moulds. The wheel used is sometimes a little lighter than the ordinary pottery wheel, and it is used to shape the round bodies of figures representing animals and men, or for turning out round toys, such as those which resemble melons and other fruit. Heads and necks are made in clay moulds, which are made and baked by the potters themselves, and legs and arms are roughly shaped by hand and joined on to the trunk. Moulds are, at times, used for the whole toy, but most commonly for such parts only as can be detached from them without risk of breaking. After joining together the two halves of a moulded toy, or the various pieces of a toy made in parts, an instrument called a "khurda" or "cholna"—such as is used in ordinary pottery

work—is employed to scrape away any irregularities in the joins, and to make the surface smooth. The toys are then smoothed with water, dried for 24 hours, and baked for a day preparatory to colouring and glazing. The oven is a hole in the ground, and a heap of toys is raised in it two or three feet high. The whole is covered over with mud plaster, and a hole is left down the centre for the application of the fire. If damaged during or after baking, the pieces of a toy are stuck together again with baked clay, powdered and mixed with gum, and the toy is then coated with chalk and gum or water. When this is dry, the pattern to represent the clothes, beard, &c., is roughly traced, and colours ground and mixed with water or gum, are applied with a brush of squirrels' or camel hair, or with a feather. When the painting is complete, glaze is applied over it. Where pottery is glazed, toys are glazed in the same way as the pottery, but the most common glaze for toys is a mixture of resin with mustard oil. Chalk mixed with gum or oil, or with oil and turpentine, is also used, and a glaze is occasionally applied. The cheapest glaze is that composed of resin and oil, and it is, therefore, most commonly used. After rebaking the toys for the glaze, they are ready for sale, although further decoration can be effected by sticking on bits of artificial gold leaf to represent the trappings of horses, turbans, &c. The price of the smaller toys depends on their size and the amount of ornamentation on them. A man can make 25 to 30 large toys, and from 40 to 50 small toys, in a day. The toys made are extremely rough, and it is with difficulty that one perceives what each is intended to represent, and both form and colour are very inartistic. Efforts are being made in Amritsar to educate the taste of the public by the distribution of good plaster casts; but an invitation to the toymakers to attend the Normal School met with no response. The toymakers expressed their willingness to attend, if assured of larger profits than at present, and had no doubt correctly gauged the public taste for cheap and gaudy articles, in preference to those which exhibit greater artistic beauty, at a higher price. Europeans have not influenced the fashion in toys, except by furnishing models for the grotesque figures that abound of sahibs and menisahibs, soldiers, policemen, and the like; and certain terra cotta figures made at Ambala are copies, made in moulds, of English models, bought in the bazaar, but very few of this description of toy are made, as there is no market for them. A notable use to which the skill of a toymaker in Delhi has been turned is in making terra cotta models of snakes, copied from certain plates, which are beautifully made and coloured. The present style of toy is characteristically Indian, and must remain unchanged until the buyers of toys have acquired some of the rudiments of artistic taste. Under the conditions in which the industry is carried on, it is unlikely to increase in extent; but, on the other hand, the import of cheap German and other

European toys of wood and tin is said to be making its influence felt, and the native industry, small as it is at present, appears to have a still more restricted future before it.

MINERAL WEALTH OF NICARAGUA.

In a recent report upon the rich mineral zones that are now being worked in the Republic of Nicaragua, the United States Consul at Managua says that, in addition to the vast mountainous system extending to the Atlantic, rich in minerals, but yet unexplored, there are the auriferous mineral districts of New Segovia and Chontales, which to-day produce the gold ore that is exported from Nicaragua. The mineral district of La Libertad, in Chontales, is the most ancient, as well as the best developed in the country, although the machinery is as yet of the most primitive character. Most of the machinery used in the mines is moved by rude hydraulic turbine wheels and steam-power. It generally consists of one or more batteries of four large mallet triturators of the California system, and one or more cups in which the ore is beaten or ground. In Boaco, of the department of Chontales, there are two mines, but they are operated in the crudest way. One is worked by means of an old mallet engine, the other by an ancient system called *molinete*. In the department of Segovia the mines are richer, but the bad condition of the roads makes the introduction of machinery very difficult, so that no gold vein is worked that yields less than one ounce per ton. All the hills, all the mountains, and almost all the rivers in Segovia contain veins, placers, and pockets of gold and silver, croppings of copper, tin, antimony, lead, and other metals, samples of which formed a conspicuous part of the Nicaraguan exhibit at the Paris Exhibition. Nevertheless, almost all the entire region remains undeveloped, with the exception of the mines Macueslizo and Dipilto, which, in times past, gave rich production of silver to the old Spanish colony, and are now abandoned only because there is more to be made in gold mining. In the mineral districts of Jicaró, Murra, Los Encinos, and Las Vueltas there are no less than twenty mines in operation, with six plants of machinery of ancient construction, which are used in reducing gold ores. The district of Jelpanca, which comprises also San Juan and El Pericon, has at least twelve mines that are non-producing because of the miner's lack of capital. There are mines of extraordinary richness in the district of Cuje that are not operated with profit, for the want of running water to triturate the ore. Most of the mines in this district are worked by the *molinete* system. There are in Segovia, Chontales, and Matagalpa, traces of placer diggings that were worked with profit in the days of Spanish conquerors. The richest placer diggings are those along the Prinzapulca and Wawa rivers on the Atlantic coast. The veins of the Prinzapulca and Wawa districts

contain both gold and silver, and in the proportion of .001 to .015 per cent. of gold, and .001 to .015 per cent. of silver in each ton of ore. The *moline* system, referred to above, is the same as that known in Mexico as the *arastra*. The *arastra* is composed of a circular granite paved bottom, from six to twenty feet in diameter, surrounded by a wooden enclosure over two feet high, with a vertical wooden shaft in the centre provided with two or more projecting arms, to which large blocks of granite are attached by means of chains. This primitive but effective machinery is operated by mules, when water power is not available. When in motion, the *arastra* is charged with two hundred pounds of ore, with some water. A quarter of an hour afterwards the balance of the whole charge, from four to five hundred pounds, is introduced. As soon as the ore is turned into mud, one or two ounces of quicksilver are pressed through a dry cloth over the thick pulp. A sample is taken from time to time with a horn spoon, washed, and examined. When free gold is perceived, after the amalgamation has gone on for some time, more quicksilver may be added. After four or five hours the pulp is diluted with water and discharged. The next charge is treated in the same way, and so on until one hundred or one hundred and fifty tons are worked through. The quicksilver is used always in proportion with the gold—one ounce or one ounce and a half to one ounce of gold. The use of too much quicksilver makes the amalgam thin, causes an imperfect amalgamation, and a loss in quicksilver which is often found beneath the bottom rock. When the reducing and amalgamating process is finished, the slime is washed off and the amalgam cleaned up, subjected to pressure, and retorted.

Obituary.

A. RECKENZAUN.—Mr. Anthony Reckenzaun, the well-known electrician, died on Saturday, 11th inst., at 2 a.m., at his residence at Stockwell. He was born in 1850 at Graz, and the first twenty-two years of his life were spent in Austria, where he received a thorough technical education, and gained special knowledge in engineering construction. In 1872, he came to England, and, in 1882, he was elected a member of the Society of Arts. On January 16, 1884, he read a paper before the Society on "Electric Launches," and in April, 1887, a paper on "Electric Locomotion," for which he was awarded the Society's silver medal. Mr. Reckenzaun was a frequent attendant at the Society's meetings, and usually joined in the discussions when electrical subjects were brought forward. He was author of a book on "Electric Traction on Railways and Tramways," in which special department of

traction he was a well-known specialist. He was vice-president of the Old Students' Association of the City and Guilds of London Institute, a member of the Institution of Electrical Engineers, the American Institute of Electrical Engineers, and the Vienna Electro-technical Society.

MEETINGS FOR THE ENSUING WEEK.

TUESDAY, NOV. 21.—Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. William J. B. Clerke, "The Tansa Works for the Water Supply of Bombay." 2. Mr. Jagannath Sadasewjee, "The Baroda Waterworks." 3. Colonel S. S. Jacob, "The Water Supply of Jeypore, Rajputana." 4. Prof. Franz Kreuter, "The Design of Masonry Dams." Statistical, Geological Museum, Jermyn-street, S.W., 7½ p.m. Opening Address by the President, Mr. Charles Booth, "Life and Labour in London: First Results of an Inquiry Based on the 1891 Census."

Zological, 3, Hanover-square, W., 8½ p.m. 1. Messrs. G. W. and E. G. Peckham, "The Spiders of the Family *Atidae* of the Island of St. Vincent." 2. Mr. P. R. Uhler, "List of the Hemiptera Heteroptera collected in the Island of St. Vincent by Mr. Herbert H. Smith, with Descriptions of new Genera and Species." 3. Dr. G. Lindsay Johnson, "Observations on the Refraction and Vision of the Seal's Eye."

WEDNESDAY, NOV. 22.—SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Capt. M. H. Hayes, "The Conformation of the Horse from an Artistic Point of View."

Geological, Burlington-house, W., 8 p.m. 1. Prof. W. C. Brögger, "The Basic Eruptive Rocks of Gran (Christian District): a Preliminary Notice." 2. Frank Rutley, "The Sequence of Perlitic and Spherulitic Structures (a Rejoinder to Criticism)." 3. Prof. H. J. Johnston-Lavis, "Enclosures of Quartz in Lava of Stromboli, &c., and the Changes in Composition produced by them."

Patent Agents, 19, Southampton-buildings, W.C., 7½ p.m. 1. Adjourned Discussion of Mr. E. Carpmal's Paper, with a resolution thereon. 2. Mr. J. C. Fell, "Anomalies of the Swiss Patent-law Administration."

THURSDAY, NOV. 23.—Sanitary Institute, Parkes Museum of Hygiene, 74A, Margaret-street, W., 8 p.m. Dr. Sinclair White, "Metallic Dusts—Cutlery, Tool-making, and other Metal Trades."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Professor George Forbes's Paper, "The Electrical Transmission of Power from Niagara Falls."

FRIDAY, NOV. 24.—Physical, Science Schools, South Kensington, S.W., 5 p.m. 1. Prof. A. W. Rücker, "The Magnetic Shielding of Concentric Spherical Shells." 2. Prof. S. M. Minchin, "The Action of Electromagnetic Radiation on Filus containing Metallic Powders."

SATURDAY, NOV. 25.—North-East Coast Institute of Engineers and Shipbuilders, The Athenæum, West Hartlepool, 6 p.m. Mr. J. Nodder, "The Dangerous Working Heat of Mild Steel, and the Effect of Annealing and Air Cooling."

Journal of the Society of Arts.

No. 2,140. VOL. XLII.

FRIDAY, NOVEMBER 24, 1893.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Proceedings of the Society.

SECOND ORDINARY MEETING.

Wednesday, November 22, 1893; FRANCIS COBB, Treasurer of the Society, in the chair.

The following candidates were proposed for election as members of the Society :—

Batley, William, care of Messrs. C. E. Clifford and Co., 200, Piccadilly, W., and 5, St. George's-road, S.W.

Broughton, Urban H., Chicago, Illinois, U.S.A.

Dadd, Frank, Wilton-house, Hyde-vale, Blackheath, S.E.

Edis, Colonel Robert W., 14, Fitzroy-square, N.W.
Geflowski, E. Edward, 5, Stratford-studios, Kensington, W.

Hodson, Frederic Walter, Loughborough, Leicestershire, and Abbey-buildings, Westminster, S.W.

Ogden, Charles Edwin, 155, Aldersgate-street, E.C.
Rainey, William, R.I., Fishbourne, Chichester, Sussex.

Stewart, David, M.A. (Lord Provost of Aberdeen), Banchory, Kincardineshire.

Willett, William, Hatfield-house, Mill-hill-park, W.

The paper read was—

THE HORSE FROM AN ARTISTIC POINT OF VIEW.

BY M. HORACE HAYES, F.R.C.V.S.

Late Captain "The Buffs."

My object in reading this paper is to direct your attention to truth and beauty in the delineation of the horse, when stationary as well as in movement.

I may explain that some of the facts which I shall bring forward, have been discussed to more or less length in a book, "The Points of a Horse," which I have lately published. Their application to art is, however, more or less new.

In writing this for publication I encounter the difficulty of referring to the illustrations

which I have the honour of showing on the screen, but which I am unable to reproduce here.

I in no way wish to occupy your time uselessly in going over well-trodden ground in the province of equine locomotion, which was first studied in an exact manner and in great detail by Professor Marey (1873), by means of an instrument similar in principle to the cardiograph. I see, by reference to the *Journal of the Society of Arts*, that, nine years after the appearance of the work of the French *savant*, Mr. Muybridge delivered a lecture to the Society, in which he assumed that he was the pioneer of this study, and that, previous to the evening on which he spoke, artists had remained in ignorance of the movements of the horse in its various paces. It is evident that Mr. Muybridge, whose valuable labours with the camera I in no way wish to underrate, knew more about photography than of French scientific literature. This subject has been so well thrashed out by him, and more lately by Anschütz, that there remains but little more to learn about it. Colonel Duhouset, who published his book, "Le Cheval," in 1881, gave the results of his investigations on the proportions of the horse, and being an artist himself, and a follower of Professor Marey, redrew the action of horses in motion, which Géricault and other great painters had rendered in a wrong manner.

I am so ignorant of the conventional rules of art, that I put forward, with considerable hesitation, the statement that a picture of a horse should be true to nature, and should satisfy the requirements of the sentiment expressed by the painter. Thus, if he wishes to show that a horse is handsome, he should place him in a handsome pose; if he desires to represent him in movement, he should give him the "feeling" of motion. Horses have been such good friends to me, that I wish to speak only of the manner by which they may be depicted at their best.

It has been the custom of writers on equine conformation, from Bourgelat, who wrote in 1808, to Goubaux and Barrier, the second edition of whose work appeared in 1890, to regard the proportions of the horse as those of a standard animal, the type of which is represented by the ordinary hunter or trooper. If, however, we examine the various breeds of horses both in the United Kingdom and abroad, we shall find that there are two well-marked extremes, namely, the racehorse and the heavy cart horse, and that the "points"

of intermediate classes are made up of combinations, in various proportions, of the two. We have at one end of the scale an animal whose chief characteristic is the possession of speed; at the other, one which is distinguished by immense strength. As examples, I may give Ormonde and the champion shire mare, Chance. As intermediate classes, I may show an English cob and a high-caste Arab. If, as has been pointed out by Professor Marey in his book, "*La Machine Animale*," we examine the muscles of various animals, we shall find that those of strength are, comparatively speaking, short and thick; those of speed, long and thin. We have, for instance, the short sternum, with its deep keel, of the albatross, and the long one of the homing pigeon; the short thick legs of the cart-horse, and the long, thin ones of the galloper.

Among the *Felideæ*, also, we have in the tiger an incarnation of strength; in the cheetah and lynx, of speed. As the functions of the body are the same in both classes of the horse, its proportions remain unchanged. Hence, the nearer a horse approaches the thoroughbred the shorter will be his body compared to his height at the withers; and *vice versa*. Thus, Ormonde was about three inches higher than he was long; and Chance, about nine inches longer than she was high. To these facts, which I believe I have been the first to point out, we must add that of the length of the head being proportionate to the length of the body, and not to the height of the withers, which is largely composed of the length of the forelegs. Another fact, which had escaped notice before the appearance of my book, is that the length of the neck is more or less proportionate to that of the limbs, and not to that of the body; for on the length of neck depends the length of those muscles which draw the fore limb forward, and which, consequently, are muscles of locomotion.

I may briefly run over the following proportions, which are common to all classes of horses:—

Length of body = $2\frac{1}{2}$ to $2\frac{2}{3}$ times the length of head.

Height at withers = height at croup.

Length of head = depth of body at lowest part of back.

Distance of top of head to corner of mouth = distance of point of hip to point of buttock.

Width of head = half length of head.

Owing to the head being comparatively far removed from the body, it gives one the impression of being smaller than it really is,

As a rule, English artists greatly exaggerate the length of "quarter," namely, the distance from the point of the hip (anterior iliac spine) to the end of the tuberosity of the ischium. They often make it a full head in length, if not more. The cause, no doubt, of this was the knowledge that length of pelvis is a mark of beauty. Meissonier, who always tried to obtain correctness, steered clear of this fault, and of the equally common one of making the head too small. It is not at all unusual to see a painted or sculptured horse with a head belonging to a horse ten or twelve inches smaller than the one which furnished the body. Landseer, who was also very careful to preserve truth, continued the mistake, made by the older artists, of putting the shoulder joint too high up. Such a position implies the existence of the marked defect of the animal having a short scapula. I may here remark, in passing, that, as the muscles which connect the fore limb to the trunk are inserted on the scapula, length of that bone is an indication of weight-carrying power.

The beautiful curves of the front view of the head of a well-bred horse contrast well with the straight lines which bound the face of an underbred animal.

The proportions of the head, like those of the body, do not vary according to class. Thus the width of the head, viewed in profile, is about half its length; and in race horses, equal to the width of the neck at the angles of the lower jaw. In cart horses, the neck at this part is much thicker. Owing to muscles of locomotion being attached to the scapula and humerus, we have the thick shoulders of the cart horse and the flat ones of the racer. The fatally easy but ignorant method of taking an average horse is well exemplified in the delineation of the legs. As the joints of the fetlock and pastern act as springs to mitigate the evil effects of concussion, we find that in those countries in which the ground is hard and dry, the pasterns of horses reared there are more sloping than in those that are bred and reared on soft soil. We have the representation of a remarkably sound pair of forelegs which belonged to an Arab horse, who, as racing men say, liked to "hear his hoofs rattle." If we examine them still further we shall, besides the extreme obliquity of the pasterns, be struck with the near approach of parallelism between the cannon-bone and back tendons, which is a characteristic of the Eastern horse

and English thoroughbred. We see this also well shown. The further we recede from the galloper and approach the cart horse, the greater difference is there between the width just below the knee and that at the fetlock. The two special points of beauty about the hocks are the comparative size of the head of the metatarsal bone, and ability to straighten the joint. The only difference between the fore and hind limbs to which I need draw attention is that the pasterns and hoofs, when in a natural state, of the hind extremity are more upright than those of the fore limb.

I need hardly draw attention to the "lighting up" of the horse's appearance by the pricking forward of the ears and the proud carriage of the tail. I may also draw attention to the good effect of a horse being placed against the sky. When a horse is viewed in profile he looks best when his nearer fore foot is more advanced and his nearer hind foot is more drawn back than its fellow. We see this position well shown in the Brahminee bull represented. Here the curves of his horns, hump and dewlap are very fine. In the next photograph, the position of the horns is slightly changed, and the artistic effect is lost. The effect of the ears is good in the Burchell's zebra. I may mention in passing that this is the only ass which has horse-like ears. In fact his conformation resembles that of the horse much more nearly than that of *equus zebra*, or of any other ass, except the extinct quagga, a photograph of which, by the kindness of that admirable photographer, Mr. Frank Haes, I am able to show you on the screen. I cannot resist showing you a photograph of an Arab pony and lady, as it has some claims to artistic merit.

It has been truly said that the domain of the artist is to depict what he sees. As he cannot see attitudes which do not exist; he is not justified in putting his horses into attitudes which the animal never assumes. As long as we remain ignorant, we may be contented with pictures of moving horses in impossible positions. But when we know that such positions are impossible, the "feeling" of motion is lost to us with respect to such works. Hence the artist who aspires to satisfy the requirements of educated men must depict animals in motion truthfully. Many of the positions of the canter and gallop do not give the feeling of motion, and should consequently be rejected by the artist, who must rely solely on those that are both true and artistic. Never having seen any of the funny positions adopted by

horses in the canter or gallop, no amount of knowledge can make them true to us. As cases in point, I give the following photographs. As a galloping horse flashes past us, we find that we are unable to take within our scope of vision his entire body, but we can accurately follow the movements of either his fore or his hind limbs. Hence we get the feeling of motion by shutting off or blurring either pair, as in some of the photographs. Here the straightened fore leg is very effective. Not long ago, Mr. John Charlton told me that the only way to give motion of a horse drawn at the canter or gallop was to have him off the ground. I made no reply, but set to work to obtain a photograph of a horse at the canter with all four feet on the ground, and yet with the feeling of motion. I now beg to submit the result to your judgment. The photograph of the canter appears to me to be effective. I give another with one hind leg on the ground.

In the action of the leap we have (1) the raising of the fore hand by the extension of the fore limb; (2) propulsion obtained by the straightening out of the hind limbs; (3) "landing" with the fore limbs, from the elbow to the hoof, straight; and (4) "getting away" from the fence in the four time of the gallop. If, for instance, the near fore is the first to touch the ground, the sequence will be: near fore, off fore, near hind, off hind; near fore, and so on. This is the four time of the fast gallop. The distinction between the gallop and canter, which I believe I have been the first to point out, is that in the latter pace the second hind foot to come down on the ground, is preceded by the opposite fore foot at a very short interval, or is accompanied by it, so as to make the classical canter of three time. The canter, therefore, is a pace in which the stride of the horse is short. If he gradually lengthen it, he will insensibly change the canter into the gallop. I will show presently four photographs of the leap, two of which I took at Sandown-park Steeplechases, and the other two at the Dublin Horse Show of last year, by the kind permission of the Committee of the Royal Dublin Society.

The following is a short description of the lantern slides exhibited:—

1. Ormonde. This horse is actually higher at the withers than he is long in the body; notice also, how low down the point of his shoulder is, and the length of his neck, and that he has no exaggerated quarter.

2. This is a champion shire mare who has

taken several prizes ; she is not so high at the withers as she is long. One great peculiarity about the cart horse is the short neck. The length of neck should be proportionate to the length not of the body, but of the legs. If a horse looks to have a good place for the collar to fit, he is not fit to ride ; he is made for harness. The late John Leech made all his horses with lumpy shoulders. A riding horse, especially a jumper, should have fine shoulders.

3. A horse immediately between the two extremes, a handsome Arab. The neck is not so long as Ormonde's, but much longer than the cart horse. The head is about the depth of the body. In all these horses the proportions of the body remain pretty constant, though the legs vary and the head is proportionate to the length of the body, not to the height.

4. A cob, coming nearer to the cart horse type. It is a bad cob, his neck is short, more like a cart horse, but his legs are longer.

5. Another cob, showing the proper position of the legs to get an artistic picture.

8. An Irish hunter, nearly thoroughbred, extremely good. Notice the beautiful setting-on of the forearm with the cannon bone, and the beautiful slope of shoulder. Mares are slighter as a rule across the loins and the back ribs than horses.

7. A tigress, to show strength as contrasted with speed ; short powerful legs.

8. A cheetah : notice the great length of the limbs, both hind and fore, showing great speed.

9. A lynx : showing the same characteristics.

10. The first glance at this horse's head shows him to be underbred ; all the lines are straight.

11. The head of a thoroughbred showing beautifully modelled curves. A line drawn across the eyes, and from each eye to the top of the occipital crest, makes an equilateral triangle.

12. The cart mare again, with her ears put back, showing the different impression it produces.

13. A horse with a bumpy forehead, a certain sign of a fault in temper, probably because he has more brains. Horses never do tricks for the love of admiration, like dogs.

14. A horse with a very high occipital crest. They are generally flat, but a high crest is a beauty, as it shows a good development of the muscles which draw the fore limb to the front.

15. A horse's head to show the eye. Many artists make mistakes in the eye : some draw horses to bird's eyes, some to human eyes ; but the horse has an eye of his own.

16. A horse with beautiful sloping shoulders and a beautiful neck.

17. The legs of an Arab racehorse. An Englishman would say his pasterns were too sloping ; but in a hot climate where the ground is so hard this is an advantage. Arabs have usually more sloping pasterns than English horses. Also notice the parallelism between the back tendons and the cannon bone.

18. The legs of another wellbred horse ; in which the setting-on of the forearm is very good.

19. An underbred horse, but with beautiful legs.

20. A racehorse, whose pasterns are getting a little too straight ; he would not be able to gallop on hard ground. A common fault in horse pictures is to make the fetlocks round, which is a sign of overwork ; they should be flat.

21. A saddle horse, with the legs of a cart horse, much thicker at the fetlock than below the knee.

22. A very bad hind leg ; tied in below the hock. There are greater indications of ignorance in drawing the hock than in almost any other point, especially the tendency to portray curbs. They should come straight down from the point of the hock.

23. A sickle-hocked horse ; with such a shape the hind leg cannot be sufficiently straightened.

24. A beautiful hock. The whole limb comes down like a wedge of great beauty.

25. This, if possible, is still better : a straight dropped hind leg and immense width of bone just below the hock, and beautiful gaskins.

26. An Australian steeplechaser, a very beautiful horse. Australian horses, taken all round, are better than we have in England, probably owing to the dry climate, which is more congenial to them.

27. A statue by a very famous sculptor. The head is too small, not being more than a third of the length, if so much, and the shoulder joint is set too high.

28. A statue in Calcutta of Lord Mayo. A horse never has a tail like that, and he is represented in moving in what the French call *passage*, a kind of gait in which the horse dances alternately from one diagonal to the

other. Lord Mayo would never have ridden a horse that danced about like that.

29. A thoroughbred English racing pony, which looks full of life. A horse to look like that must always be in a large open space; then he is on the alert and looking about him.

30. A Brahmin bull, showing the position in which quadrupeds all look well. The curves of his horns harmonise with the lines of his body and his dewlap.

31. The same animal in a different position. The curves of the horns do not harmonise.

32. Burchell's zebra, showing that he is more like a horse than an ass; as shown by the size of his head, his ears, and his fore legs. Artists should remember that this zebra closely resembles a horse.

33. The mountain zebra, which is an ass. He has a big head and long ears; he is black and white; the other one is brown and yellow. Notice the rudimentary dewlap.

34. Another photograph of the same. This animal will soon be extinct, while Burchell's zebra still exists in large herds.

35. The quagga, now quite extinct. This is a photograph taken many years ago by Mr. Frank Haes by the wet collodion process.

36. A nice looking horse, with a lady rider.

37 to 47. All these are photographs of horses in motion, illustrating the points above mentioned.

We should bear in mind that, for the sake of stability, the fore leg in "landing" over a jump should have its direction made (in drawing) to pass through the centre of gravity.

As an interesting point of atavism, I beg to bring to your notice a photograph which I lately took of a horse with the second digit almost as perfect as that of the *Hipparion gracile*.

DISCUSSION.

The CHAIRMAN, in inviting discussion, said he believed Mr. Muybridge was the first man to bring forward the real position which horses took in motion, as shown in these photographs. Marey was, no doubt, studying the anatomy of the horse, and of the feet and legs especially; but the credit of actually showing the positions in galloping and trotting was due to Muybridge. He was surprised to see in some of these views how they were getting nearer and nearer to some of the old Japanese paintings. It was something quite new for a member of the College of Veterinary Surgeons to take up this subject from an artistic point of view, and they were much indebted to Captain Hayes.

Mr. JOHN LEIGHTON remarked that in a photograph the nose being in advance of the rest of the horse would be slightly enlarged. The old horses of Lebrun and Rubens all had birds' eyes; but it was then the fashion for historical pictures to be incorrect. The ears of a mare were very different from those of a horse, so much so that a rider could tell the sex of the animal directly he got in the saddle. All the horses shown were in profile, none in a front view, so that you did not see the head, which was very important. He should like to know if Captain Hayes could throw any light on the question of rat-tailed horses. Meissonier discovered the action of a horse by making an erection of boards, against which he got horses to trot, canter, or amble, and marked each hoof a different colour, so that he could note and sketch them as they passed, he lying flat on the ground for the purpose. In the Elgin Marbles there were beautiful representations of horses in motion. He should like to know something about the tails of the Burchell zebra and the other species, if they were similar or not.

Mr. MALLETT said it was very remarkable what a tendency there was amongst artists to diminish the size of the head in a horse. There was a picture in the National Gallery, for which £23,000 was paid a few years ago, representing King Charles on a grey horse, in which the head was not more than half the length it ought to be, and there was in the South Kensington Museum an elaborate tomb having a number of panels filled with horses, in which the same fault was noticeable.

Mr. FRANK HAES said he had never had the opportunity of taking photographs of horses in rapid motion, as all his work was done thirty years ago with wet collodion, but he had noticed horses a great deal, and could bear out a great many of the statements made as to their proportions. Mr. Muybridge referred all the imperfections in equestrian portraits to the statue of Marcus Aurelius in Rome, which was the commencement of all the badly sculptured horses in the world.

Captain HAYES, in reply, said he could not establish Professor Marey's reputation as being the pioneer in all this work, as he had not his book "*La Machine Animale*" with him, but it was published in 1873, and was translated into English, and he could only refer those interested to it. It would be found there that horses were depicted correctly from deductions made by the instrument used by Professor Marey. Mr. Muybridge said in his lecture, that until he showed his photographs artists knew nothing about the movements of the horse, which was not correct, because Professor Marey explained the whole movements absolutely correctly; the only claim to originality which could be sustained on the part of Mr. Muybridge was that he was the first to do the photographic part. Natur-

ally he had taken his photographs in profile, because he did not want to make photography usurp the place of art, and if he had shown pictures foreshortened in any way he would have been told that photographic perspective was always wrong. He had often tried to find out whether an animal was a horse or a mare by its head alone, and had often heard it said, "Oh, that horse has a mare's head, I don't like it," but he had asked experienced men scores of times and never found that they could tell the sex by the head. He did not doubt there was a difference but he could not find out what it was. If you said you could tell by the peculiar look, that was not enough for exact statement. With regard to rat tails, his opinion was, that a better-bred horse was in an advanced stage of evolution, and the vertebrae of the tail were smaller than in an unbred horse, and, consequently, the hair was finer and not so bushy, and you found a short dock. In the Arab and East Indian horse, you have always looked for breed in the short dock, which showed the horse had attained a high state of evolution. He was sorry he had left out all about the muzzle of the horse, but he might say that half the horses exhibited in the Royal Academy had congestion of the lungs; they had their nostrils wide open, which a horse never had, unless he were breathing very rapidly or was distressed. The nostrils were very dilatable, but, when the horse was standing still, they fell in at once. The tail of the zebra was a very interesting point. The mountain zebra had a tufted tail, like a cow's or a donkey's, but Burchell's zebra had a tail more like that of a horse, the hair continuing up, more or less, the whole way.

The CHAIRMAN then moved a hearty vote of thanks to Captain Hayes, which was carried unanimously.

Miscellaneous.

PARIS EXHIBITION, 1900.

M. Carnot, President of the French Republic, has, on the report of the Minister of Commerce, published a decree regulating the organisation for the Universal Exhibition to be held at Paris in the year 1900. M. Alfred Picard has been appointed General Commissioner of the Exhibition. The following is the Report of the Minister of Commerce, and the Decree of the President of the French Republic:—

Rapport au Président de la République Française.

Paris, le 9 Septembre, 1893.

MONSIEUR LE PRÉSIDENT,—Un décret du 13 juillet, 1892, a décidé l'ouverture à Paris, en 1900, d'une exposition universelle des œuvres d'art et des produits industriels.

Peu après, mon honorable prédécesseur, M. Jules Roche, a institué, par arrêté du 5 Novembre, 1892, une commission préparatoire ayant pour mission d'étudier les moyens propres à réaliser la future exposition.

Cette commission sera sans doute bientôt en mesure de se prononcer sur les questions qui lui ont été soumises, c'est-à-dire sur le choix de l'emplacement, sur le programme général des constructions et sur le régime financier de l'entreprise.

Malgré le délai qui nous sépare de la fin du siècle, il me paraît utile de fixer dès aujourd'hui, dans ses grandes lignes, l'organisation des services de l'exposition. En effet, l'importance exceptionnelle de l'œuvre, les difficultés auxquelles peut donner lieu la conversation partielle des monuments du Champ de Mars, les problèmes délicats qui se rattachent aux voies d'accès et de transport, quel que doive être l'emplacement choisi pour nos grandes assises pacifiques de 1900, tout exige une période d'élaboration plus longue que lors des précédentes expositions.

Les dispositions que j'ai l'honneur de soumettre à votre haute approbation sont dictées par l'expérience du passé. Elles reproduisent celles de 1889, sauf quelques changements qui portent en eux-mêmes leur justification.

Comme en 1889, les services seraient placés sous l'autorité du ministre du commerce, de l'industrie et des colonies. Mais, suivant la tradition pour ainsi dire constante, qui n'a été interrompue qu'une fois, ils auraient à leur tête un commissaire général doté de pouvoirs étendus et d'une large initiative. Sans porter atteinte à l'action essentielle du ministre, responsable devant le Parlement, l'institution du commissariat général assurerait plus complètement l'unité de direction et l'esprit de suite indispensables au succès; elle établirait mieux l'harmonie entre les diverses parties d'un organe éminemment complexe par sa nature même et par les éléments dont il est formé; elle dégagerait le chef d'un département ministériel qui voit son rôle s'élargir incessamment et auquel sont attachés des devoirs incompatibles avec le souci des détails d'une exposition.

La répartition des services diffère peu de celle qu'a fait ses preuves en 1889. Il me suffira de signaler la division des travaux en deux groupes distincts correspondant l'un à l'architecture, l'autre à l'art de l'ingénieur. L'homme éminent n'est plus qui, grâce à un savoir, à un talent et à une autorité indiscutables, avait su réunir et diriger l'ensemble des travaux de la dernière exposition. On peut se demander où seraient les épaules assez robustes pour porter un tel fardeau.

Parallèlement aux services actifs, une commission supérieure, une sorte de grand conseil apporterait au Gouvernement le concours de ses lumières et de ses avis pour les questions importantes qui lui seraient déférées par le ministre. Cette commission supérieure, très fortement constituée, se recruterait dans les Chambres, le conseil d'Etat, le conseil général de la Seine, le conseil municipal de Paris, les académies,

la haute administration, les chambres de commerce, les grands établissements de crédit, les corps savants, le haut enseignement professionnel, les entreprises de transport, l'industrie des constructions métalliques. Toutes les compétences, tous les intérêts y seraient puissamment représentés.

Le ministre ne pourvoirait à la nomination des directeurs et chefs de service que progressivement, au fur et à mesure des besoins. Mais le commissaire général serait immédiatement désigné. Il pourrait ainsi préparer avec plus de maturité l'œuvre patriotique dont la lourde charge sera remise entre ses mains.

Si vous voulez bien approuver mes propositions, j'ai l'honneur de vous prier, monsieur le Président, de vouloir bien revêtir de votre signature les deux projets de décrets ci-joints.

Veuillez agréer, monsieur le Président, l'hommage de mon profond respect,

TERRIER,

Le ministre du commerce, de l'industrie et des colonies.

Le Président de la République Française.

Sur le rapport du ministre du commerce, de l'industrie et des colonies, vu le décret du 13 Juillet, 1892, instituant à Paris, en 1900, une exposition universelle des œuvres d'art et des produits industriels ou agricoles. Décrète :—

Art. 1^{er}.—Les services de l'exposition universelle de 1900 sont placés sous l'autorité du ministre du commerce, de l'industrie et des colonies, et dirigés par un commissaire général.

Les attributions réservées au ministre comprennent les rapports avec les Chambres, l'approbation des projets d'ensemble, les mesures d'ordre général, la délégation des crédits au commissaire général l'approbation des comptes, la nomination des directeurs et chefs de service.

Art. 2.—Il est institué au ministère du commerce, de l'industrie et des colonies une commission consultative, dite commission supérieure de l'exposition.

Cette commission, présidée par le ministre du commerce, de l'industrie et des colonies, a pour vice-présidents le ministre de l'instruction publique, des beaux-arts et des cultes, le ministre de l'agriculture et le commissaire général.

Elle se compose de cent membres, non compris le bureau, savoir :

Le sous-secrétaire d'Etat des colonies ;

Huit sénateurs ;

Douze députés ;

Le vice-présidents du conseil d'Etat et deux conseillers d'Etat, appartenant à la section des travaux publics, de l'agriculture, du commerce, de l'industrie et des postes et télégraphes ;

Le préfet de la Seine ;

Le préfet de police ;

Le président du conseil général de la Seine ;

Le président du conseil municipal et huit membres de ce conseil ;

Le directeur général de l'exploitation de l'Exposition universelle de 1889 ;

Le directeur général des finances de l'Exposition Universelle de 1889.

Deux membres de l'académie des sciences ;

Deux membres de l'académie des sciences morales et politiques ;

Trois membres de l'académie des beaux-arts ;

Le président de la chambre de commerce de Paris ;

Les présidents des chambres de commerce de Bordeaux, le Havre, Lille, Lyon, Marseille et Nancy ;

Le président du tribunal de commerce de la Seine ;

Le gouverneur de la banque de France ;

Le gouverneur du crédit foncier ;

Le directeur du crédit lyonnais ;

Le directeur général des postes et télégraphes ;

Le directeur du commerce intérieur ;

Le directeur du commerce extérieur ;

Le directeur de l'enseignement industriel et commercial ;

Le chef du cabinet du ministre du commerce, de l'industrie et des colonies ;

Le vice-recteur de l'académie de Paris ;

Le directeur des beaux-arts ;

Le directeur de l'agriculture ;

Le directeur des affaires commerciales au ministère des affaires étrangères ;

Le directeur des chemins de fer au ministère des travaux publics ;

Le directeur des routes, de la navigation et des mines au ministère des travaux publics ;

Le directeur général de la comptabilité publique ;

Le directeur général des douanes ;

Le directeur général des contributions indirectes ;

Le chef d'état-major général du ministre de la guerre ;

Le chef d'état-major général du ministre de la marine ;

Un directeur désigné par le ministre de l'intérieur ;

Un directeur désigné par le ministre de la justice ;

Le vice-président du conseil général des ponts et chaussées ;

Le directeur de l'école nationale des ponts et chaussées ;

Le vice-président du conseil général des mines ;

Le directeur de l'école nationale supérieure des mines ;

Le directeur des travaux de Paris ;

Le directeur de l'école centrale des arts et manufactures ;

Le président de la société des ingénieurs civils ;

Le directeur de l'école nationale des beaux arts ;

Le directeur du conservatoire national des arts et métiers ;

Les directeurs des compagnies de chemins de fer de l'Est, de l'Ouest, d'Orléans, de Paris à Lyon et à la Méditerranée, et du Midi ; le directeur de l'administration des chemins de fer de l'Etat ; l'ingénieur en chef de l'exploitation de la compagnie des chemins de fer du Nord ;

Le président de la compagnie générale des omnibus de Paris ;

Le président-directeur de la compagnie générale des voitures à Paris ;

Le président de la compagnie générale transatlantique ;

Le président de la compagnie des messageries maritimes ;

Le président de la compagnie des bateaux parisiens ;

Un représentant de la presse parisienne ;

Un représentant de la presse départementale ;

Trois représentants de l'industrie des constructions métalliques.

Les membres non désignés par leurs fonctions sont nommés par décret.

La commission supérieure est appelée à émettre son avis sur les questions qui lui sont soumises par le ministre du commerce, de l'industrie et des colonies.

Elle peut se subdiviser en comités, qui élisent leur bureau.

Art. 3.—Le cadre des services de l'exposition est le suivant :

1^o Secrétariat général.—Affaires générales. Personnel. Service médical. Police. Secours contre l'incendie. Presse. Entrées de faveur.

2^o Direction des services d'architecture.—Construction des palais et pavillons. Contrôle des constructions métalliques. Contrôle des palais et pavillons construits par les nations étrangères, les administrations publiques, les colonies, les pays de protectorat et les particuliers.

3^o Direction des services de la voirie, des parcs et jardins, de l'eau et de l'éclairage.

4^o Direction des l'exploitation.—Service général de la section française. Service général des sections étrangères. Installations générales, architecture. Installations générales, mécaniques et électriques. Service spécial des beaux-arts. Service spécial de l'agriculture. Service spécial des colonies et pays de protectorat. Catalogue ; diplômes et médailles.

5^o Direction des finances.—Entrées, matériel, comptabilité et caisse.

6^o Service du contentieux.

7^o Service des fêtes.

Art. 4.—Les directeurs et chefs de service sont réunis en comité, sous la présidence du commissaire général, pour l'étude des questions communes à plusieurs services.

Art. 5.—Des comités techniques ou administratifs peuvent être constitués auprès du commissariat général par arrêté du ministre du commerce, de l'industrie et des colonies.

Art. 6.—Les services de l'exposition sont compatibles avec des fonctions publiques.

Au cas où ils quitteraient temporairement leur emploi, les fonctionnaires détachés à l'exposition seraient maintenus dans les cadres de leur administration, pourraient y recevoir de l'avancement et conserveraient leurs droits à la retraite.

Art. 7.—Des arrêtés ministériels fixent les indem-

nités attachées aux fonctions et emplois des services de l'exposition.

Art. 8.—Le ministre du commerce, de l'industrie et des colonies est chargé de l'exécution du présent décret, qui sera inséré au *Bulletin des Lois* et publié au *Journal Officiel* de la République Française.

Fait à Fontainebleau, le 9 Septembre, 1893.

CARNOT.

Par le Président de la République : Le ministre du commerce, de l'industrie et des colonies, TERRIER.

Le Président de la République Française,

Sur le rapport du garde des sceaux, ministre de la justice, et du ministre du commerce, de l'industrie et des colonies, vu le décret de ce jour réglant l'organisation des services de l'Exposition universelle de 1900. Décrète :—

Art. 1^{er}.—M. Alfred Picard, président de section au conseil d'Etat, rapporteur général de l'Exposition universelle de 1889, vice-président de la commission préparatoire d'Exposition universelle de 1900, est nommé commissaire général de l'Exposition universelle de 1900.

Il conservera ses fonctions actuelles.

Art. 2.—Le garde des sceaux, ministre de la justice, et le ministre du commerce, de l'industrie et des colonies, sont chargés, chacun en ce qui le concerne, de l'exécution du présent décret, qui sera inséré au *Bulletin des Lois* et publié au *Journal Officiel* de la République Française.

Fait à Fontainebleau, le 9 Septembre, 1893.

CARNOT.

Par le Président de la République : Le garde des sceaux, ministre de la justice, E. GUÉRIN.

Le ministre du commerce, de l'industrie et des colonies, TERRIER.

USE OF COKE FOR HEATING, COOKING, AND FIRING STEAM-BOILERS.

Two causes have retarded the generalisation of the use of coke in the heating of apartments. In the first place, the absence of heating apparatus in which coke might be burnt economically ; and, secondly, its dearness as compared with coal. On the other hand, the increased impetus given to the consumption of coal-gas, through its application to cooking and motive-power, with the diminution of coke consumption on account of the extended use of regenerative furnaces in gas-works, has caused stocks of coke to accumulate.

The managers and engineers of Belgian gas companies organised competitions of heating appliances especially designed for utilising coke, one of the most successful of which competitions was that of the Association des Gasiers Belges in 1887. This association lately instituted a fresh competition, in order to judge of the progress accomplished, and to

bring the results prominently before the public. The jury, presided over by M. Depaire, Professor of Chemistry at the Brussels University, with Dr. Janssens, Chief Inspector of the Brussels Hygiène Service, as Vice-President, was composed of men of practical knowledge and experience.

A sum of 10,000 francs (£400) was set aside for recompensing the exhibitors of the best appliances, which were classed under the following heads:—*A.* Open fireplaces; *B.* Closed stoves for *appartements*; *C.* Closed stoves for public buildings; *D.* Hot-air stoves; *E.* Portable foot-warmers; *F.* Cooking stoves; *G.* Bakers' ovens; *H.* Special furnaces for heating by hot water or steam; and *I.* Furnaces for steam boilers and other industrial purposes. These classes it was afterwards found necessary to subdivide into series, on account of the diversity of the seventy-three appliances sent in for competition.

The fireplaces and stoves for domestic use were tested in eight rooms of various size, in a dwelling-house placed at the disposal of the committee by the Gas Company of Saint Josse-ten-Noode, a suburb of Brussels. Each appliance was kept under fire for at least a fortnight, the consumption of coke being noted with the greatest care, and the results tabulated under the heads of "Hourly consumption in normal working" and "Hourly consumption *en veilleuse* (damped down)," being the mean of sixteen observations in the former case and fifteen to twenty in the latter.

When working *en veilleuse* in continuous-combustion stoves, *i.e.*, those provided with a feed-chamber that may be closed hermetically, the air admission may be regulated so as to maintain the fire with a very small quantity of fuel, *i.e.*, from half to three-quarters of a cubic decimetre (32 to 48 cubic inches) per hour. As the fire is fed in accordance with the consumption, it may smoulder for a very long period, from 24 to 48 hours, without any danger to the health, since the gases are always taken off by the chimney, and also without fear of conflagration, because there is no possibility of the smallest particle of fire escaping into the room.

The coke for each series of heating apparatus was of the same origin and composition; and the regularity of the fire was carefully noticed. Conformably with the dictates of *hygiène*, there was no damper in the uptake flue, the intensity of the fire being entirely regulated by the admission of air under the fire-bars. Careful observations were made whether this regulating was easy and certain, *i.e.*, whether the fire preserved, without appreciable variation, the intensity given to it; whether it gave out deleterious products or not; whether it became red-hot or not on the outside; and whether it was possible to quickly reduce the fire to a moderate intensity by merely moving the regulator or slide for admitting air. Notice was also taken whether the ashes might be easily removed, or whether they formed a compact clinker adhering to the side of the fire-box. In this

manner it was possible, without further examination, to eliminate defective stoves, &c.

The construction of each appliance was studied in detail, as regards strength, tightness, ease of taking to pieces, and elegance. In the case of apparatus for heating large buildings, hot-air stoves and special furnaces for heating water or generating steam, the jury first studied the drawings; and the preliminary examination sufficed to cause the rejection of such appliances as did not fulfil the conditions of the programme. The stoves, &c., were then examined as regards their calorific yield or useful effect, expressed by the ratio of the quantity of caloric available for heating a given space to the total quantity of heat produced by the combination. The direct appreciation or estimation of the quantity of heat utilised presents insurmountable difficulties; but it might easily be deduced from the relative quantity of heat carried away by the products of combustion. This quantity of heat was calculated by means of the following data: (*a*) the temperature of the gasses generated by the combustion—temperature observed inside the uptake by a thermometer placed at an equal distance from the hearth for all appliances of the same class; (*b*) the quantity of carbonic acid, and that of carbonic oxide, if there were any, contained in the products of combustion.

These gases were collected by a tube inserted in an aperture made in the uptake flue, opposite the thermometer mentioned above. The content by weight of carbonic anhydride was determined by drawing a predetermined volume of gas through four tubes with caustic potash, followed by a tube containing sulphuric pumice stone, the products of combustion having been previously deprived of their water by passing through a tube with weighed sulphuric pumice stone. The contents by volume of carbonic oxide was determined, by means of a Bunte test-tube, by absorption with the aid of cuprous chloride of ammonia, after elimination of the carbonic acid and oxygen.

In the tests carried out on the stoves, &c., which were awarded a prize, no appreciable quantities of carbonic oxide were found to exist in the products of combustion. A considerable number of prizes were awarded to stoves in which the combustion was considered to be satisfactory.

THE FRENCH FAN INDUSTRY.

A report on the subject of French fan making has lately appeared in the *Monde Economique*, from which it appears that it was only at the commencement of the century that this industry assumed any degree of importance in that country. At the Exhibition of 1806, the Minister of the Interior stated that France was in a position to supply fans to America and a large part of Europe. In the following year, however, the industry commenced to show signs of falling off, for

the Paris Chamber of Commerce wrote, on the 28th March, 1807, to the effect that there were only 50 makers before the Revolution, who together employed 2,000 male and 4,000 female hands. After the Revolution, the number of fan makers increased to 300 or 400, but two-thirds of these soon retired from the industry. The manufacture declined considerably in 1816, when the Austrian Government prohibited the importation of fans in that part of Italy subject to its domination, and when Spain trebled the import duties on these articles. From statistics which have been prepared on the subject, it appears that, in 1825, there were in Paris only 15 makers, giving employment to about 1,000 workpeople, of whom 334 were men, 500 women, and 166 children. From 1840 to 1846, the fan-making industry showed signs of improvement; in 1847, there were 122 makers, giving employment to only 565 workpeople. At the present time, the number of Parisian fan-makers is about 200, and the number of workpeople 2,000, divided into fan-makers properly so called, makers of fan leaves, painters and colourers, paper glazers, makers of trimmings, menders, mounters, polishers, varnishers, riveters, &c., all occupations essentially local, and constituting one of the most important branches of labour in connection with *articles de Paris*. The fan-making industry has now to contend against the competition of cheap Chinese and Japanese articles, but this does not much affect the French article in the principal countries of the world, and more particularly in the American and Italian markets. In order to give some idea of this competition, it may be stated that the Parisian makers can turn out fans at 5.50 francs per gross, or 3 centimes each; but the Chinese paper fan is sent from Canton at the price of 9 francs the thousand, that is, 1.30 francs the gross, or 10 centimes the dozen. As regards Spain, which is sometimes looked upon as a rival to France, this country is, on the contrary, rather a customer than a rival, as she takes a large quantity of French mountings.

Notes on Books.

COAL PITS AND PITMEN: A Short History of the Coal Trade and the Legislation affecting it. By R. Nelson Boyd, M.Inst.C.E. London: Whittaker and Co.

It is said that coals were first imported into London from Newcastle in 1257. Their use was prohibited by royal proclamation in 1306, but the prohibition was not observed. It has been estimated that, in 1660, the amount of coal raised in Great Britain was 2,148,000 tons; in 1750, this was raised to 4,773,828; in 1770, to 6,205,400; and in 1795 to 10,681,728. In 1891 the output was 185,479,126 tons. The

author gives some introductory notices relating to the earliest coal pits, and then proceeds to discuss the influence of legislation on the condition of the miners. In 1879, he published a work entitled "Coal Mines Inspection, its History and Results," and the present volume is to some extent a re-casting of that book. In the Appendix is a list of Acts of Parliament regarding coal mines and miners, and the first of these was passed in 1775, for the purpose of releasing the Scotch miners from a state of bondage. "In 1842, the late Lord Shaftesbury, then Lord Ashley, introduced a Bill for prohibiting the employment of women and young children underground in coal mines, the first of the series of measures passed by Parliament for the better regulation of mines and miners, culminating in the comprehensive Act of 1887." The Appendix also contains a list of serious colliery explosions from 1675 to 1889.

SOCIAL ENGLAND: A Record of the Progress of the People in Religion, Laws, Learning, Arts, Industry, Commerce, Science, Literature, and Manners, from the earliest times to the present day, by various writers. Edited by H. D. Traill, D.C.L. Vol. 1., to the accession of Edward I. London: Cassell and Co.

The editor has prefixed to this volume an introduction in which he explains the treatment which the subject of his book has received. The English nation is considered as a society, and the social history of the people is treated under the following seven heads. 1. Civil organisation. 2. Religion. 3. Learning and Science. 4. Literature. 5. Art. 6. Trade and industry. 7. Manners. The object of the book is twofold, and the requirements of the student as well as of the general reader have been kept in view in its preparation. This first volume carries the history from the earliest times to the accession of Edward I. Chapter I. contains an account of Celtic Britain under the title of England before the English. Chapter II. deals with the decline of the Roman power, and Britain under English and Danes. The Norman conquest is treated of in the third chapter, and Chapter IV. is devoted to the reign of Henry III. and is entitled "from Charter to Parliament, 1216-1273." The different heads referred to above, under which the history of the progress of the people is divided, are treated in each chapter, and a short notice of the chief authorities for the statements in the text is added.

ON THE ENTOMOLOGY AND USES OF SILK, with a list of the families, genera, and species of silk producers known up to the present date. By Thomas Wardle. Newcastle-under-Lyme.

This is Mr. Wardle's Anniversary Address as President of the North Staffordshire Naturalists' Field Club and Archæological Society, and contains, besides some general remarks on the history of silk, a full list of silk-producing Lepidoptera.

THE DALLASTYPE SHAKESPEARE: A Reduced Facsimile of the First Folio (1623) edition in the British Museum, photographed from the Original by permission of the Trustees. Part 1, 2. London: Duncan C. Dallas. Imp. 8vo.

As no manuscript of Shakespeare's works exists, the first complete edition of his plays published in 1623, and universally known as the "first folio," holds a unique position in literary history. Every student must refer to it, and yet the original is of so great a money value, that the volume is put out of his reach. In consequence of this, reproductions have naturally been called for, and several have appeared. The present one is a reproduction by means of the Dallastype, for which certain advantages over photo-lithography are claimed. The work will be completed in fifty-seven parts.

General Notes.

INSTITUTIONS IN UNION.—A member of the Society offers five vols. of the *Journal*—vols. xxiii. to xxvii. (1874-1879)—to the library of any Institution in Union with the Society of Arts desiring to possess them. The books are half-bound in calf. Application to be made to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C.

MILAN EXHIBITION.—Information has been received from the Science and Art Department respecting an International Exhibition to be held at Milan from May to October, 1894. Sir D. E. Colnaghi, Her Majesty's Consul-General at Florence, has reported to the Earl of Rosebery, Secretary of State for Foreign Affairs, that combined Exhibitions (Esposizione riunite) will then be held. Of the various sections into which the Exhibitions will be divided, the following will have an international character:—(1) Machinery and utensils for the making of oil and wine; (2) workmen's exhibition; (3) photography; (4) advertising; (5) postal and stamp collection; (6) sport, in relation to animal races and competitions.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

NOVEMBER 29.—"The Regulation of Street Advertising." By RICHARDSON EVANS. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

DECEMBER 6.—"An Artist's View of Chicago and the World's Fair." By FREDERIC VILLIERS.

DECEMBER 13.—"Carriage-way Pavements for large Cities." By LEWIS H. ISAACS. SIR BENJAMIN BAKER, K.C.M.G., F.R.S., will preside,

Papers for meetings after Christmas:—

"London Coal Gas and its Enrichment." By PROF. VIVIAN LEWES.

"Automatic Balance of Reciprocating Machinery, and the Prevention of Vibration." By W. WORRY BEAUMONT.

"Experiments in Aeronautics." By HIRAM S. MAXIM.

"Automatic Gem and Gold Separator." By WILLIAM S. LOCKHART.

"The St. Pancras Electric Light Installation." By HENRY ROBINSON, M.Inst.C.E.

"Electric Signalling without Wires." By WM. HENRY PREECE, F.R.S.

"Modern Development of Illustrated Journalism." By HORACE TOWNSEND.

"The Adam Architecture in London." By PERCY FITZGERALD.

"Pewter." By J. STARKIE GARDNER.

"Railway Extension in India." By JOSEPH WALTON.

"The Petroleum Fields of India: their Present and Future." By R. D. OLDHAM.

"Indian Currency." By J. BARR ROBERTSON.

"Telegraphic Communication between England and India: its present Condition and Future Developments." By E. O. WALKER, M.Inst.C.E., C.I.E.

"Chota Nagpore: its Mineral Wealth and its Industrial Resources, and its value to India." By J. F. HEWETT.

"The Water Supply and Sanitation of the North-Western Provinces and Oudh." By SIR AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieutenant-Governor of the North-Western Provinces and Oudh.

"The Forthcoming Antwerp Exhibition." By EDOUARD SÈVE.

"Morocco." By Captain ROLLESTON.

"Paraguay." By A. F. BAILLIE.

INDIAN SECTION.

The meetings of this Section will take place on the following Thursday Afternoons, at Half-past Four o'clock:—

January 18; February 15; March 8; April 5, 26; May 24.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on the following Tuesdays, at Half-past Four or Eight o'clock :—

January 23; February 20; March 6; April 17; May 1, 29.

APPLIED ART SECTION.

The meetings of this Section will take place on the following Tuesday Evenings, at Eight o'clock :—

January 30; February 13, 27; March 13; April 10; May 8.

CANTOR LECTURES.

The following courses of Cantor lectures will be delivered on Monday Evenings, at Eight o'clock :—

HENRY BLACKBURN, "The Art of Book and Newspaper Illustration." Three Lectures.

LECTURE I.—NOVEMBER 27.—*The Illustrator of to-day*.—Education of the artist—Drawing for reproduction—Modern methods and requirements—Influence of photography on the illustrator—Examples of drawings for reproduction, good and bad.

LECTURE II.—DECEMBER 4.—*The Engraver*.—The various methods of reproducing drawings and photographs for the press—The substitution of photographic and mechanical engraving for handwork—Specimens of the newest processes of illustration.

LECTURE III.—DECEMBER 11.—*The Author*.—His part in the illustration of books—His handwriting—The decorative page—Examples of illustration—Archaic decorative, topical—The Book of the Past—The Book of the Future.

PROFESSOR FRANK CLOWES, D.Sc., "The Detection and Measurement of Inflammable Gas and Vapour in the Air." Four Lectures.

January 22, 29; February 5, 12.

HUGH STANNUS, F.R.I.B.A., "The Decorative Treatment of Traditional Foliage." Four Lectures.

February 19, 26; March 5, 12.

CAPTAIN W. DE W. ABNEY, C.B., F.R.S., "Photometry." Three Lectures.

April 2, 9, 16.

HENRY CHARLES JENKINS, A.M.Inst.C.E., "Typewriting Machines." Two Lectures.

April 30; May 7.

JUVENILE LECTURES.

Two lectures, suitable for a juvenile audience, will be delivered by WALTER GARDINER, M.A., F.R.S., on "Plants: their Foes and Defences," on Wednesday evenings, January 3 and 10, 1894, at 7 p.m.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, NOV. 27.—SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Henry Blackburn, "The Art of Book and Newspaper Illustration." (Lecture I.)

Imperial Institute, South Kensington, 8 p.m. Mr. James Dredge, "The British Colonies at the Chicago Exhibition."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Dr. John Murray, "Antarctic Exploration."

Actuaries, Staples-inn-hall, Holborn, 7 p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Rev. H. A. Boys, "Zante and its Earthquakes."

TUESDAY, NOV. 28.—Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion upon the papers on "Impounding-Reservoirs in India, and the Design of Masonry Dams," by Mr. Clerke, Mr. Sadaseewjee, Colonel Jacob, and Professor Kreuter.

Medical and Chirurgical, 20, Hanover-square, W. 8½ p.m.

Photographic, 50, Great Russell-street, W.C., 8 p.m.

Colonial Inst., Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Mr. Archibald R. Colquhoun, "Matabeleland."

WEDNESDAY, NOV. 29.—SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Richardson Evans, "The Regulation of Street Advertising."

British Astronomical, University College, W.C., 8 p.m.

THURSDAY, NOV. 30.—Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Prof. J. Sully, "The Uses of Humour."

Sanitary Institute, Parkes Museum of Hygiene, 74A, Margaret-street, W., 8 p.m. Dr. J. T. Arlidge, "Textile Manufactures, Silk, Cotton, Woollen, and Linen Industries."

FRIDAY, DEC. 1.—Civil Engineers, 25, Great George-street, W., 7½ p.m. (Students' Meeting.) Mr. Leonard H. Appleby, "Forms of Tensile Test-Pieces."

Geologists' Association, University College, W.C., 8 p.m. 1. Mr. Thomas Leighton, "Notes on a Discovery of Fossils at Little Stairs Point, Sandown Bay, Isle of Wight." 2. Mr. A. Smith Woodward, "Notes on the Sharks' Teeth from British Cretaceous Formations." 3. Mr. Geoffrey F. Monckton, "The Breaking-up of the Ice on the St. Mary River, Nova Scotia, and its Geological Lessons."

Queckett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Journal of the Society of Arts.

No. 2,141. VOL. XLII.

FRIDAY, DECEMBER 1, 1893.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

On Monday evening, 27th November, Mr. HENRY BLACKBURN delivered the first lecture of his course on "The Art of Book and Newspaper Illustration."

The lectures will be printed in the *Journal* during the Christmas recess.

APPLIED ART SECTION COMMITTEE.

A meeting of the Committee of the Applied Art Section was held on Wednesday, 29th November, at 4 p.m. Present: Sir George Birdwood, K.C.I.E., C.S.I., M.D., in the chair; Francis Cobb, Lewis F. Day, I. Hunter Donaldson, General Sir John Donnelly, K.C.B., C. M. Kennedy, C.B., J. Hungerford Pollen, Vincent Robinson, J. Sparkes, Hugh Stannus, F. Wardle, with Sir Henry Trueman Wood, Secretary of the Society, and Henry B. Wheatley, Secretary of the Section.

Proceedings of the Society.

THIRD ORDINARY MEETING.

Wednesday, Nov. 29, 1893; SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., M.D., LL.D., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Bishop, Edward, Woodward, Steele's-road, Haverstock-hill, N.W.

Bontor, Frank Arthur, 35, Old Bond-street, W.

Brett, John, A.R.A., Daisyfield, Putney, S.W.

Downer, Frederick, Blake-house, Watford, Herts.
Frampton, George, 32, Queen's-road, St. John's-wood, N.W.

Gardner, W. Biscombe, Thirlestane, Hindhead, near Haslemere, Surrey.

Mills, William, Bonner's-field, Sunderland.

Over, George Edward, Rugby.

Taylor, Edmund, Tower-buildings, 22, Water-street, Liverpool.

Temperley, Charles, 72, Bishopsgate-street Within, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Adam, Peter, Cairndhu, Kidderminster.

Ahmed, Sayyed Zaheer Uddin, B.A., care of Hutchinson and Co., 1, Northumberland-avenue, W.C.

Ahsanulla, Nawab, The Hon. Khwaja, C.I.E., Dacca, Bengal.

Annandale, Charles J. R., 265, Queen's-road, New-cross-gate, S.E.

Ansted, William Alexander, 3, Ranelagh-villas, Grove-park, Chiswick.

Barrett, Walter, 135, Church-street, Chelsea, S.W.

Baumont, William Worby, M.I.C.E., 100, Palace-road, Tulse-hill, S.W.

Becker, Harry Otto, The Minorities, All Saints', Colchester

Bevan, Paul, M.A., 46, Queen's-gate-terrace, S.W.

Birch, Colonel Richard Graham, 9, Montague-avenue, Brockley, S. E.

Bishop, Edward Francis, India-office, Whitehall, S.W.

Boulton, James, Crayford Mills, Stratford, E.

Bristow, George William, 102, Manor-road, Brockley, S.E.

Buckmaster, Martin Arnold, 22, Talgarth-road, West Kensington, W., and Ashleigh, Hampton Wick.

Bull, John C., 18, Bexley-road, Erith, Kent.

Bumsted, David Alexander, Blyth-road, Bromley, Kent.

Burt, Charles William, 26, Westbourne-park-villas, Bayswater, W.

Cadett, James, Ashtead, Surrey.

Caird, David, Hyde-park-court, W., and Todleusk, Ulverston, Lancashire.

Caulfield, Francis, Edington, Langside, Glasgow.

Cecil, Lieut.-Col. Lord William, 87, Queen's-gate, S.W.

Chalmers, John Hicklenton, The Elms, Highgate-road, N.W.

Chance, George Ferguson, M.A., Clent-grove, near Stourbridge.

Christy, Gerald, 38, Outer Temple, W.C.

Cleghorn, William, jun., Clepington, Dundee, and Bayfield, Broughty Ferry.

Collins, Richard, 1, London-road, High Wycombe, Bucks.

Crosthwaite, Sir Charles H. T., K.C.S.I., Naini Tal, India.

- Croweller, William Thomas, F.I.Inst., Cyclists' Club, 8, Queen Anne's-gate, S.W., and Kent-lodge, Sidcup, Kent.
- rowley, William Henry, Oakbourne, 8, Oakholme-road, Sheffield.
- Deane, Col. H. Bargrave, 5, Eaton-place, S.W.
- Dove, John, 1A, Cannon-street, E.C.
- Duthy, John Walter Brand, Cronberg, Arterberry-road, Wimbeldon.
- Dvorkovitz, Paul, 6, Willow-bridge-road, Canonbury, N.
- Evans, Sir David, Alderman, K.C.M.G., Ewell, Surrey.
- Eyton, Thomas Ruxton Slaney, Walford-hall, Shrewsbury.
- Faviell, Charles V., Westcombe, Westcombe-park-road, Blackheath, S.E.
- Fleet, Charles, 8, Park-crescent, Brighton.
- Gilbertson, Edward, Garth-house, Torrs-park, Ilfracombe.
- Greenwood, Captain William Nelson, Glasson Dock, Lancaster.
- Harvey, Thomas Morgan, Portland-house, Basinghall-street, E.C.
- Henwood, Paul, College-hill-chambers, E.C.
- Henty, Walter, 32, Eaton-square, S.W.
- Hill, Seymour McCalmont, M.A., 10, King's Bench-walk, E.C., and 24, Norfolk-square, Hyde-park, W.
- Hutchinson, Lieut.-Colonel William Lacy, R.A., 11, Phillimore-terrace, Kensington, W.
- James, Henry, Holly Bowers, Chislehurst, Kent.
- Jancke, Fritz, 8, Linden-road, West-green, South Tottenham.
- Jenkinson, Thomas, 21, Mincing-lane, E.C.
- Jephson, Captain Sir Alfred, R.N., 5, Seville-street, Lowndes-square, S.W.
- Jones, D. Pugh, Llanelly, South Wales.
- Koeller, William, Fernwood, Wimbledon-park, Surrey.
- Key, William, Central Chambers, 109, Hope-street, Glasgow.
- Lavers, Nathaniel Wood, The Woodlands, Long Ditton, Surrey.
- Leale, Rev. Thomas Henry, 4, St. Agnes-place, Kennington-park, S.E.
- Leon, Auguste, 21, Tregunter-road, South Kensington, S.W.
- Liddiard, James Edward, Rosemont, North Finchley, N.
- McConnel, W. H. Marsh-green, Ashover, Chesterfield.
- Middleton, Professor J. H., M.A., South Kensington Museum, S.W.
- Musgrave, Alfred Simson Joseph, 3, Clifton-villas, Bradford.
- Nichols, Horace C., 11, Argyll-street, Regent-street, W.
- Nicholson, Robert Beattie, 115, High-street, Lowestoft.
- Oates, Charles Parkinson, 43, St. George's-square, S.W.
- Ogilvy, John Francis, 21, The Grove, Boltons, S.W., and Sun-court, 67, Cornhill, E.C.
- Pennant, Philip Pennant, Nantlys, St. Asaph.
- Potter, Henry Arthur, 105, Fordwych-road, West Hampstead, N.W.
- Prendergast, Major-General Guy Annesley, 6, Bramham-gardens, S.W.
- Price, Frederick Wakefield, 49, Guilford-street, Russell-square, W.C.
- Quirk, William Henry, 9, Gracechurch-street, E.C., and Altyne-house, Sutton, Surrey.
- Richards, Henry Charles, 2, Mitre-court-buildings, Temple, E.C.
- Robinson, Richard Atkinson, 195, Brompton-road, S.W.
- Sadasewjee, Hurrychund, Great Indian Peninsula Railway, Bombay.
- Sharp, John Edmund, 176, Belsize-road, N.W.
- Shearer, Arthur, 173, Ham-park-road, Forest-gate, E.
- Sifton, Thomas Elgood, 53, Shepherd's-bush-green, W.
- Simpson, Augustus John, Haverhill, Suffolk.
- Slater, Sydney Herbert, 126, Highbury New-park, N.
- Slattery, Henry Francis, 13, Old Broad-street, E.C.
- Spring, Francis Joseph Edward, Acting Consulting Engineer to Government of Bombay Railways, Bombay, and care of W. Watson and Co., 27, Leadenhall-street, E.C.
- Stevens, William, Technical Institute, Ealing, W.
- Stott, William, 66, Adelaide-road, N.W.
- Straight, Sir Douglas, 125, Victoria-street, S.W.
- Thornton, Henry, 5, George-street, Euston-road, N.W.
- Usher, Richard, Bodicote, Banbury, Oxon.
- Veit, Charles F., 28, Bartlett's-buildings, Holborn-circus, E.C.
- Wade, Joseph Armytage, Hornsea, near Hull.
- Weeks, John Wills, 276, Westminster-road, Liverpool.
- Wheelton, James, Albert terrace, Brinnington, Stockport, and Carrington-road Works, Stockport.
- White, Francis Alfred, Uplands, Foyle-road, Blackheath, S.E.
- White, Henry Osborne, 35, North-bank, Regent's-park, N.W.
- Williams, William Clement, 13, Akedo-road, Halifax, Yorks.
- Wilson, Sir Alexander, Red-house, Dartmouth-grove, Blackheath, S.E.
- Wright, Alfred, Bessingby-hall, Bridlington, Yorkshire.

The CHAIRMAN expressed his regret, which he was sure would be felt by all present, that Mr. Richardson Evans was laid up with influenza. Mr. John Richmond, joint secretary with Mr. Evans to the National Society for Checking the Abuses of Public Advertising, had kindly consented to take his place and read his paper.

The SECRETARY read the following letter from Mr. Evans:—

“1, Camp View, Wimbledon,
“Nov. 28, 1893.”

“The doctor forbids me to do work of any kind this week, I must, therefore, give up any faint hope that remained of being at the meeting to-morrow. It would have been a particular pleasure to me to have met Sir George Birdwood, and to have had his protection for my little paper. During my eight years of Indian service, I had very pleasant reason to know how much he did for Indian art. Will you make my apologies, and express my regrets to all.

SEBASTIAN EVANS.

The paper read was—

ARCHITECTURE AND ADVERTISEMENTS.

By RICHARDSON EVANS.

When I had accepted the invitation to address you, and the sense of the honour done to me had given way to a perception of the responsibility I had undertaken, I naturally fell to thinking of the character of the assembly that it was to be my privilege to address. I reflected that not for years nor for decades only, but for generation after generation there had been heard within these walls discourses from eminent persons, directed to the encouragement of the arts, manufactures, and commerce of the country, and it occurred to me that I should be possibly the first to break this long tradition, to come forward boldly to plead not for production, but for the restraint of production; not for the development of industry, but for setting limits to certain morbid growths; not for creation, but for prevention. I consoled myself, however, by the thought that I should at least be faithful to the spirit which animated the founders of your Institution. For the Society of Arts would no longer fulfil the objects with which it was established, if it did not aim directly and persistently at improving the conditions of life for the people of England. We have to change our methods if we desire to be faithful to the original ideal. And the proceedings of your Society, which have been a mirror of the industrial and artistic life of the nation for more than a century, will continue to reflect the tendencies of contemporary life only by taking note of the dangers which menace as well as the positive arts which adorn civilisation.

If we transport ourselves—calling historic imagination to our aid—to the time when an earlier race of members of your Corporation

entered into possession of this beautiful fabric, we can realise that in those days, happier in some respects, less happy in others, the problem was wholly to enlarge the supply of what was beautiful or comely. The ordinary architecture of the last century possibly left much to be desired. And as we know to our cost, there was a sad want of sensibility to the charms of the older work, and a stalwart contempt for what, in these days, we should consider picturesque effect in domestic buildings. Comfort was studied to the neglect of grace. Speaking as I do in a district which commemorates by its very name the fame of the two brothers who played so prominent a part in reconciling beauty of form with rigid regard for homely utility, I ought perhaps to hesitate about accusing their age of any conscious tolerance of ungainliness. Many of the public edifices of the time attest a striving after the fanciful, although to our eyes, the result did not always respond to the excellence of the intention. But if we confess, as I fear we must, that there were periods in which grace was little sought and seldom found, there was a redeeming absence of deliberate disfigurement. A street might consist of long rows of uniform brick houses, in which the only thought of the designer was to arrange for windows that would admit the light, and doors that would allow free exit and entry. If any one chooses to object to the monotony of aspect thus produced, few are sufficiently admiring of Harley-street or Gower-street to contradict with any emphasis. But the absence of style was more than atoned for by the absence of all that could jar or wound. Charm may have been lacking, but there was a propriety, a congruity, a repose—nay, a dignity which might well be classed as a form of the picturesque. Even now, after all that the modern improver has done to give to an aspect of newness with polished granite pillars for the porch, and garish flower-boxes for the window sills, there is, to many eyes, something thoroughly refreshing in the dingy vistas of this type of thoroughfare. No one will question the grace of much of the detail, the fineness of the work done in wood, the union of strength and lightness in the ironwork. I say nothing of interiors, for my subject is concerned only with the objects which strike the eye of the wayfarer. Whether we take London in the reign of Edward III., or of Elizabeth, or of Queen Anne, it was unquestionably a place in which there was little to distress the most sensitive sight. Again, let me explain that I am

speaking of the experiences of the eye alone. The pedestrian who values a good pavement, the sanitarian who appreciates fresh air and cleanliness, the philanthropist whom the spectacle of human wretchedness afflicts, may well prefer his own time to those that have gone before. But in spite of occasional squalor, of the meanness of many of the dwellings of the citizens—of the noisome atmosphere, of the narrow ways and the abounding mud—in spite of all these things, town, as our forefathers, including perhaps our grandfathers, knew it, was a place in which one could have pleasure in walking the daily round. Most reasonably, then, did those who in the last century feel the promptings of public spirit devote themselves exclusively to the multiplication of objects which ministered to the convenience of the community, or were in themselves stately or beautiful. Those who wanted then to improve a public prospect—as the phrase went—built a church with a classic portico, or erected a statue on a well-proportioned base. It is possible to cavil at the taste displayed in many of these contributions to the embellishment of the metropolis, but, enlarging our retrospect, and taking our public edifices as a whole, from the Tower or Westminster Abbey to Somerset House or the British Museum, they form a glorious bequest from generations that have passed away.

Are we proving ourselves worthy of the inheritance to which we have succeeded? Are we faithful trustees of the relics that have been left to us by our ancestors, and that we are bound in honour to hand on to posterity? A journey on foot, in any direction whatever, from the Bank of England, or any other centre, east, or west, or central, will supply the melancholy and humiliating answer. Would Dr. Johnson, if he were with us still, dream of inviting his friends to take a walk down Fleet-street? Would Charles Lamb protest that there was no such scenery anywhere as could be had without leaving town? Would Robert Herrick, hurrying up from his pleasant Devonshire parish, vow that now at last he could live again, since he was back in London? Need I attempt here to draw a picture of what greets the eye, say, in that part of Holborn which lies between Tottenham Court-road and Holborn-viaduct? or to present a verbal photograph of the panorama of placards which surround that most beautiful of churches, St. Mary-le-Strand. Have any members of the Society of Arts been lately to Tower-hill?

If they have, they will not ask to be reminded of what they saw. If they have not, far be it from me to counsel them to purchase so dearly experience of what crimes can be committed in the name of trade.

I confine myself—for the sake of practical illustration—in detail to a survey of the Thames Embankment. There, the process of creeping disfigurement can be watched almost from day to day, and its effect studied by reference to what remains of the original beauty. We all of us, as ratepayers, have excellent reason to know that it cost some millions of public money to create that superb avenue; for superb it is, in the majestic sweep of its spaces, and in the massive grace of the chiselled granite that forms the rampart. Yet, much as we must praise the completed work, we must not refuse to confess that there was loss as well as gain. The river banks, a generation since, were unquestionably picturesque. The fleets of lazy barges moored in the stream or floating sluggishly with the tide, the motley host of minor craft, made the water thoroughfare, as seen from any of the bridges, a sight full of suggestion and beauty. At high tide there was the broad sheet of water, at low the shelving mud banks, features not lovely in themselves, and undoubtedly malodorous; but, as part of the scene, full of artistic merit. Then there were the bridges themselves; the spectator, let us hope, being so placed as to have in the foreground that masterpiece of bridge building which commemorates the most glorious event of English history. Forming part of the same group would be Somerset House, descending in its imposing terraces to the water's edge, while as background would be the mighty dome of St. Paul's and the countless spires and roof ridges of the City. As to the buildings by the river's edge, I am not afraid to take up my parable in their praise. The two shot towers were and remain—to my eyes—objects as stately and, in their way, as fine as any minaret on the Golden Horn or Campanile on the Grand Canal. Then there were the wharves with their huge mills and granaries and stores, and all the miscellaneous relics of shanties black with time, sheds that tiled roofs made gracious, decrepit old houses, edifices more modern, but not offensive, simply because they served appropriately a distinctly useful end. Add to all the infinite mutations of sky which our climate, with fickle prodigality, gives us; whether the rolling mist and brooding smoke clouds, or the ungenial clearness of the East

wind, and we need not wonder that the master painters of Great Britain have found in the Thames, above bridge and below, constant subjects for their most successful canvasses.

I am far from saying that the charm has wholly departed even now. But there has been change enough to impair, if not to destroy the grace: to mar the enjoyment of the whole, even if still much material for artistic contemplation of detail can be found by that happy class of seeker who can tolerate the vexations that come in the way of delight.

I want, by your leave, to consider the character of these changes, and to discriminate between those that every man of sense, whatever his æsthetic sensibilities may be, must accept as unavoidable and even praiseworthy, from those which are purely wanton and gratuitous—which disgrace civilisation instead of being the result of progress; and which not only call for the censure of all intelligent believers in the principle of public utility, but are susceptible of remedy.

There is, to begin with, the construction of the Embankment itself—an undertaking which made a clean sweep of what I may venture to call the picturesque higgledy-piggledy, on the Middlesex side, and substituted for it an imposing regularity. If the only thing to be considered were the desirability of providing for some elegant loiterer on one of the bridges a pleasing picture for sunrise or sunset, the decision would possibly be in favour of leaving things as they were before Sir Joseph Bazalgette waved his engineering wand over the scene. But, of course, pictorial interest is not the criterion. Cities exist to satisfy the everyday needs of the average population, not to nourish the dreams of the poet nor refresh the eyes of the landscape lover. Convenience, then, in the broad and common sense of the word, is the primary point to be considered. There was urgent need of a new line for the traffic of the metropolis: something was to be said for the view that the river which flows through the greatest city of the world ought to be flanked by massive and sumptuous edifices; many, even those who thought that the stream as it was, was fair enough, were forced to acknowledge that a promenade from which people could watch the water was needed to extend the range of general enjoyment; and public order, too, demanded the reconstruction of an area in which there was much that shocked the sanitarian and added to the anxieties of the magistrate. The construction of the em-

bankment, therefore, was good work, well done.

I am conscious that in saying this I am delivering myself of a platitude. But a platitude is necessary occasionally as an answer to misrepresentation. Those whose feelings I share on the question of disfigurements in towns, and whose convictions I seek to express, are the constant mark for the pity and the jests of writers who have never devoted ten minutes serious thought to the subject, and who think that a superficial smartness will pass muster as a substitute for right reason. These easy-going sages affect to sneer at us, or pity us, or scold us as persons who do not accept industrial development, whose judgments are befogged by mediæval mists; who do not take note of the increase of population, and are hardly aware that steam power and locomotion are great facts of the present day. It would be very easy to answer these poor scribes according to their vivacity. But, as you perceive, I prefer to stick to sense and prose.

No We, of all men, are keenly alive to nineteenth century conditions. We claim to understand them. We accept the world and the tendencies which mould society. We appreciate, as our critics do not, the law of progress. We desire only to apply it logically and consistently; to correct, in a word, an abuse which has grown up from one defect in the institutions under which we live—a defect which has caused already, and will, if uncorrected, cause ever extending injury to the common weal.

I return to the platitude. Cities do not exist for the sake of being picturesque. Facilities for manufactures, for commerce, for trade, for ease of traffic, efficiency of sanitation, and police administration: these are the things that influence the plans of our municipal ædiles. But though cities do not exist for the sake of picturesque effect, picturesqueness may be, and ought to be, an incident of city life. The other utilities I have mentioned may be reconciled to this utility; and the arrangements made for securing scope for industry, safety for life and limb, and, generally speaking, physical convenience, should be consistent with, and conditioned by, arrangements for giving fair play to the tendencies which make for the comfort of the seeing eye. If this is a platitude, it is a platitude which as yet has never received recognition from members of the House of Commons, reformed or un-

reformed, from County Council aldermen, or the magnates of the City Corporation. When the Thames Embankment was made, care should have been taken to save from unnecessary disfigurement the scene of which it is a feature. No care has been taken. Everything has been left to chance, and chance means the caprice of the individual defacer.

Presently I shall ask you to apportion responsibility. Here let me seek to portray—in sorrow rather than in anger—the result of official neglect and private competition in the senseless effort to catch the eye. Nearly a generation has passed since the roadway and the newly-created building space adjoining became an accomplished fact. Many of these places still remain areas which it would be a compliment to call a howling wilderness. It may be a matter for just complaint that those who had the letting of the sites were so long in coming to terms with those who wanted them; but that is a matter for business criticism. I may not enter into it here, and am willing to assume that all was done with a strict regard to the pecuniary interests of the public. But I do say that it showed a very grave insensibility to the principles of civilisation in any rational sense, that the vacant sites have during all these years been allowed to remain, not merely as an eyesore, but as a nuisance to the neighbourhood. It surely would have been possible to have enclosed them with a decent paling, to have kept that decent paling in a decent condition, and to have kept the land as a sort of field, which, pending the long deferred signing of the leases, would have added to the health and comfort of the neighbourhood. But all the intelligent enterprise of the eminent persons concerned appears to have spent itself in making a costly embankment. To spend a small sum yearly for the purpose of making the outlay remunerative, in promoting the ends which were supposed to justify it, seems never to have entered into the collective minds of these municipal worthies. Every building, as it successively rose from the waste, was allowed to add something positive to the aggressive meanness of the spectacle. The gable end of a new structure in one of the lateral streets, just because it was huge and ungainly, and by its obtrusive bulk thrust itself upon the eye of the pedestrian, was utilised by the occupant as a colossal tablet to announce to people half a mile away the nature of the business that was being prosecuted inside. No doubt each tenant

would plead that he was only taking advantage of a temporary chance of advertising his business, but the net result is, that the Thames Valley in this region has become a permanent hoarding on a gigantic scale, without even any alleviating variety in the character of the inscriptions.

Nor was there any relief, or prospect of relief, as the structures rose which were to form the permanent frontage. I am not one of those who seek to acquire a reputation for refined taste, by sneering at the works of modern architects. I believe that contemporary builders are not inferior to their masters and forerunners, and I have no grievance against those who severally designed the works that the intelligent foreigner may study from Waterloo-bridge. But can any one say, surveying the series as a whole, that it is worthy of the superb situation. Uniformity is not beauty; but there is a degree of contempt for congruity that approaches deliberate unsightliness. I do not think that it should have been left to pure chance whether a Queen Anne's pile in red brick should overtop a palladian façade in Portland stone, yet I own I should not murmur if each item in the architectural miscellany were left such as the designer intended it to be. Irregularity and variety are, it must be considered, part and parcel of that sturdy individualism which is still associated with the type of the true Briton. But it is impossible to approve a system of *laissez faire*, which allows the manager of a great hotel, built with a robust disregard for dignity of appearance, to crown his offence and his establishment with an enormous board, which proclaims to thousands who do not care for the information the uses to which the building is applied; nor can anyone, who dislikes strong language, trust himself to speak in adequate terms of the decision of a very learned college, which adjoins Somerset House, to destroy, by the erection of an elevated laboratory, the exquisite perfection of a façade, which is a national possession and ought to be an object of national pride and reverence.

When the people who do these things are put on their defence, they generally fall back, by way of extenuating their own sins, on the colossal enormity of the Charing-cross Railway-station and bridge. "What is the use," they say, "of being nice about trifles, when this monstrous iniquity is allowed?" It is the old old story. Because things are bad, it is not wrong to make them worse. Because

there has been negligence once, close the door for ever on precaution. Let me not be misunderstood. It was absolutely necessary that there should be railway bridges over the Thames; and I for one do not think the one which we owe to the South-Eastern Railway at all a bad specimen of its kind. It has strength and massiveness. There is no sham about it. It is what it pretends to be: a fine piece of engineering in iron work. The Rialto is more romantic; but a Rialto is not what London needs, and there is a homely grandeur about this viaduct of girders. Wordsworth, had he lived to see it, might have found as much to quicken his poetic sense in this constant procession of trains laden with their freight of men and women, full of human emotions and anxieties, as he did in the contemplation of the sleeping city from the old bridge of Westminster. Humanity has not ceased to be pathetic because it is often packed uncomfortably in third-class compartments, and has to make undignified haste to catch a train. Turner, who lived long enough to grasp the poetry of steam, would certainly have found much to paint in that never-ceasing picture of the panting, toiling locomotive monsters. I say, then, that Charing-cross Railway-bridge does not necessarily or irretrievably spoil the picturesque or jar upon the sentimental mood. Of the station itself we dare not speak with the same charity. Even had the architect tried to make it an ornament to the river side, he would have been baffled by the intrinsic difficulties. But, as a matter of fact, he was not instructed to try; and it remains probably a unique sample of a Mammoth shed—a thing without form and void. Something might even now be done to make the staring chasm a little less aggressive; but in any case, though the unwieldy bulk of the thing must more or less upset the balance of the prospect, there is an impressiveness about it which may almost reconcile us to the want of grace and harmony. One is sorry that it is there, but there it is; we must accept its presence.

But what we cannot and ought not to tolerate is the pretension of the directors to make profit out of the wrong they have done. It is nothing short of a public scandal that they should use the walls—such as they are—for advertising stations, and that they should plaster their staring posters on that part of their bridge which spans the Embankment. We must put up with their iron work; it is outrageous to affront us with their bills. Yet

I must check myself in the use of strong language; for, I fancy, that at their Board meetings they sometimes imitate Lord Clive, and stand aghast at their own moderation. Why, they might have let out the whole of the bridge to the pill men and the soap vendors, and thus prepared the way for special dividends to the shareholders. Nothing but the absence of a fertile spirit of invention has so far saved the metropolis; for one has only to look around to see evidences that delicacy and public spirit impose no restraint.

This brings me back to our melancholy itinerary of the Embankment. I forget how many hundreds of thousands of pounds have been spent in providing the gardens on it. Very beautiful they are, and great are the blessings they bestow upon the people. But to a very large extent the pleasure that has been placed, at such enormous cost, within reach of the many, has been marred—nay, destroyed—by the—I know not what to call it—of those who have control of some buildings which, by an unhappy fate, are close to two of them. I speak of certain structures which the officials of the Underground Railway describe as their stations. I am not blind to the great service performed by the District Company. I sympathise with all my heart with the struggles which the management makes to render the traffic remunerative to the shareholders. I acknowledge the singular personal courtesy of all their *employés*, from the secretary to the humblest porter. But the goodness of heart displayed below the ground level only makes the more inexplicable the inhumanity perpetrated above. If the structures where tickets are sold, and through which passengers descend to Avernus were merely grimy and shabby, no one would mind. It would be alarming news if there was an attempt to make them ornate. But why cover the walls with those deplorable painted boards? Even as painted boards they are disreputable. They resemble the faded finery of mauve and emerald green and sky blue which one sometimes sees on an East-end slattern. As advertisements they are absolutely useless. No one sees them unless he sees the station, and those who go in quest of it certainly do not need this dirty kaleidoscope to embitter their approach. The effect on the gardens is woeful. You look down the green vista, and the background is this panorama of combined dinginess and gaudiness. An order for their removal, which it would take Sir Edward Watkin only half a minute to dictate, and

which would deprive the line of no custom, and, as I think, might bring it a good deal—for I fancy what repels me repels many others—would confer a greater degree of happiness on those who frequent the gardens at Charing-cross and at the Temple than the gift of thousands of pounds for the “embellishment of the metropolis” could have the smallest chance of conferring on any similar number of people.

But the story of creeping defacement is still only half told. It is no use grumbling because the superb granite plinths are still without the sculptured groups which are needed to complete the design. But it surely is a superfluous feat of official indifference that little stumps of gas-pipe are still left sticking up in the centre of each. The railings and the gas-lamps are very beautiful pieces of metal work: ought they to be used as stands and posts for notices, according to the discretion of the County Council crossing sweepers?

These, however, are, comparatively speaking, bagatelles. The main charm of the promenade would, in a healthy condition of things, be the view of the river in its devious course. But alas for the poor pilgrim who seeks the old delight. Some purveyor of advertising appliances bethought him that if colossal gridirons could be erected on the roof ridges, huge letters could be hung on them which would show against the sky; and so trader after trader, thinking only of the chance of snatching a penny from his decent competitors, gave his orders, and lo, there was an end of the firmament, and, as it seemed, of architecture. The County Council, to their very great credit, would not stand this. But it is a proof of the want of moral courage which dooms us to the sorrows I speak of, that though the motive was, unquestionably, regard for the eye, no alderman or councillor nerved himself to recommend prohibition on this ground. By a legal fiction, the things have been forbidden, on the transparent pretext that, if they fell, they might hurt someone in the street below. And, as we have saddest reason to know, the frames that were already in possession of the sky, were allowed some years of grace—or rather some years of hideousness. By a later Act an attempt was made to bring other elevated advertisements under the ban, but concessions had to be made which, as far as my observation goes, has rather stimulated the production of Garagantuan sign-boards. An epidemic has set in on the Surrey

side. Stores and factories, that a year ago were content to fulfil in modest anonymity the purposes for which the tenants rented them, now proclaim themselves in letters legible to the tourist who surveys London civilisation from the cross of St. Paul's. The County Council, which ought to set a good example, was among the earlier offenders. Having acquired some premises with a river frontage, as a depot, some official thought that the acquisition would be of sufficient interest to the passing barges to justify a monstrous signboard. The process is at work all along the line, and very soon the view from the bridges will consist of the name, address, and occupation of a number of otherwise respectable and self-respecting firms. There is really no gain to anyone: for the practice is purely mechanical and imitative: and there is the loss to the metropolis and to Great Britain of one of the noblest of our prospects.

I have confined myself to a sketch of the river from Blackfriars-bridge to Westminster. Yet there, if the damage is greatest, and if the tendency is more open to observation, the actual instances of offence are, as yet, fewest and in themselves least grave, while much still remains untouched. But what is said of the Thames Embankment may be said, *mutatis mutandis*, of the Pool, and of the course of the stream to Gravesend, of ancient thoroughfares such as the Strand and Fleet-street, and of the trading highways in every suburb. No place is safe. One may indeed say that every place is threatened.

The evil is patent; what is the cause? It is not as some, who unjustly accuse the spirit of the age, aver, that the sense of beauty and propriety is decaying amongst us, or that art is dying. Never was there a time in which taste was more general, or the community more bent upon encouraging and developing it. Technical institutes are the fashion of the hour; picture exhibitions multiply and prosper; the demand for illustrated literature is insatiable, and is lavishly fed with work which, ten years ago, would have been the treasures of the connoisseur. Stage scenery has realised such a pitch of perfection that acting is getting to be a subsidiary detail; nor is the modern architect a whit behind those of our best times. There is a larger per-centage of admirable or tolerable façade among the new buildings than among the old. It is not, then, individual deterioration that is the cause.

We are told unceasingly that it is the spirit of competition that is the root of the evil; but

this explanation—I say it with all deference to the eminent philosophers who are all agreed to give this account of the matter—is unscientific and inadequate. The population of these islands no doubt consists of about 40,000,000 of people, all more or less concerned in making things pleasant for themselves; and publicity, let me most freely grant, is, in business matters, a cause of profit. But there are two ways of securing prominence. You may advertise yourself, but if other people do the same, you have advertised in vain. Conversely, you may keep your own place in the public eye, by preventing your neighbours from usurping more than their share. Therefore, though the desire to secure prominence is the motive which leads each individual to push himself forward, it does not at all follow that society, as a whole, has any interest in the appeal to the retina. If the opportunities of display be limited all round, no one will be the loser; indeed, there will be an aggregate gain, since all the expenditure of effort that is now wasted—and worse than wasted—in manufacturing catchpenny emblems of all sorts, will be available for purposes really useful to the community.

Thus I arrive at the conclusion that the easy good nature, the sluggishness, the immobility of public sentiment, is the cause of the tendency which, as individuals, we nearly all deplore. In every other department of life the legislator has recognised the need of regulation. Municipal bye-laws, framed under Acts of Parliament, or the express letter of innumerable statutes, tell us imperiously that our houses must conform to certain rules, that our sanitary appliances must be of a prescribed kind, that we must drive, if we have a carriage, on one side of the street and not on the other. The time has come now for extending the principle of Regulation to a sphere in which the need of protection is most crying, but which as yet has been overlooked. A society, as many of my hearers are perhaps aware, has been formed with the object of giving effect to this view of public policy. It is prepared to invoke the aid of legislation just so far as to enable local representative bodies to regulate advertising displays in public places, in accordance with the ascertained will of residents. But it relies largely upon moral influence and the opportunities presented by friendly social intercourse.

I have said nothing of the disfigurements of the country, although these appear to many to be more glaring, and on that account more

susceptible of remedy. For my own part, though I shall rejoice if even a perceptible impression be made on the plague which now destroys the charms of the landscape along many of our great lines of railway communication, I have always felt that there is a picturesqueness in towns which calls out no less imperiously for vigilant defence, and I therefore received with much satisfaction the suggestion that the town should be my theme. I am not disposed to be sanguine or exacting. It will be slow work to reclaim shopkeepers from practices which have become habitual. But suppose—I do not suggest that the attempt can wisely be made just now—suppose, I say, there were a rule in London forbidding inscriptions on business premises covering more than a specified space, or in letters above a specified size, or beyond a specified height from the ground; suppose omnibuses were not permitted to be advertising vans; nor humanity to be insulted by the employment of sandwich men; nor hoardings multiplied for the mere sake of harbouring posters, can any one, I ask, doubt that our streets would wear a more beautiful and dignified aspect, that town life would be sweeter, that the morality of trade would be improved, and its essential dignity vindicated. Then at last we should see the vision of a beautiful London realised, for Competition would then be a wholesome rivalry in pleasing instead of impressing the eye.

DISCUSSION.

The CHAIRMAN, in inviting a discussion on the paper, said that, as a medical man, his objection to the great and growing plague of disfiguring advertisements was on sanitary grounds. In some of the streets of London and its suburbs the “poster” advertisements covered acres of surface, and the slow putrefaction of these masses of paper and paste were not simply a great eyesore and nuisance, but an undeniable source of disease, and he believed that the spread of influenza was, in an appreciable measure, due to it. The paper and paste, and the wooden hoardings on which the paper of these acres upon acres of “posters” was always decaying, thus providing a prolific forcing bed for all sorts of disease-producing germs, and under an enlightened sanitary system, quite apart from considerations of public decency and propriety, advertising by means of posters ought everywhere to be resolutely suppressed. He thought also that all disfigurement of streets and rural scenery by advertisements of any class ought to be forbidden by law and under very heavy penalties. What was the use

of spending large sums of money out of the pockets of the British taxpayers in providing schools for national art education, if we allowed the artistic sense of the people to be outraged, seared, and gradually destroyed by the ceaseless contemplation, at every turn in the streets and suburban roads, of the outrageous public advertisements of all sorts with which London and its neighbourhood were now afflicted. It was, however, very gratifying to find that public opinion was at last becoming sensitive on the subject. The existence of the Society, of which Messrs. Richardson Evans and John Richmond were the joint secretaries, was a sign of this. Then there was the most encouraging fact that Messrs. Augustine Birrell, John Burns, and W. Caine were promoting a Bill in Parliament for the express purpose of regulating public advertising. We might look hopefully also to the co-operation of the County Council in the matter. As to the reforms needed he thought that advertising by means of "posters" being unquestionably a noisome nuisance, and probably highly insanitary, should be absolutely prohibited; that all external advertisements in the streets would be strictly subordinated to the architectural features of the buildings on which they were placed, a rule, the enforcement of which would make each advertisement positively decorative; and that outside advertisements of any kind, save for the information of their customers should be prohibited on railway stations, whether inside or outside, and on all public buildings, such as churches and publichouses. The The highest eyesores in London, and the most discreditable to it, as the capital, not only of the United Kingdom but of the empire, were the disfigurement of its railway stations by the acres upon acres of impertinent advertisements with which they were covered, both internally and externally. These offences to the artistic sense of humanity destroyed much of the pleasure of life for poor men who had not the means to make their own homes artistic, for whose sake chiefly we so desire to preserve the beauty of our streets and fields and lanes, or, at least, an unrestricted view of the sky; for the inevitable tendency of all such unnatural oppressions of life as foul air, impure water, and disfigured scenery, and particularly sordid and hideous streets, is to drive men—who can only claim the sky and the outside of other people's houses as their own—into intemperance and every other form of brutalising dissipation.

Mr. H. H. STATHAM said he agreed so entirely with the paper, that he hardly had anything to add. The rage for putting up placards had so increased of late years that unless something was done to check it all London would be entirely defaced. The only defence he had ever heard of it was in a little play by Mons. Charles Garnier, acted in Paris before the architectural congress, in which a billsticker sets up a claim to having introduced polychromy, and so relieved the monotony of the walls. He had seen

the same thing urged seriously in England, that it lightened up the streets. The answer was that it was impossible to have any architectural beauty if a billsticker could put up his placards everywhere. He sympathised very strongly with the early part of the paper, which dealt with the way in which the Thames Embankment had been treated. It was one of the most splendid sites for an architecture which should be an attraction to the whole world if made the most of, and there ought to be more legislative interference with the buildings allowed to be put there. In contradistinction to the one old and fine building, Somerset-house—which some modern critics sneered at—there was a succession of buildings, the majority of which had no claim to any architectural character at all. They were not like bills, which could be taken off the walls; a building was put up and could not be removed until it was worn out. But this was a little apart from the main point of the paper, as to which he quite agreed, and should like to hear any practical suggestions made for legislation on the matter, without undue interference with the liberty of the subject.

Mr. ROBSON said he had joined the society to which reference had been made, and had come there in the hope of hearing some practical suggestions. People often said these things were matters of taste, but when you got to the bottom, matters of taste were matters of knowledge. In a civilised country these intolerable abortions could not be allowed to continue, but some practical method must be devised for dealing with the matter. The sanitary aspect of it alluded to by the Chairman was very important, and he had no doubt it would have more weight with the public than anything else. He should be glad to co-operate in any means which could be suggested.

Mr. H. BLACKBURN said he had been much interested in the paper, which he thought ought somewhere to have dealt with the question of decency, as well as with artistic considerations. He remembered when Charing-cross station was about to be constructed, and when the Bill was in Parliament authorising it; and he would suggest that on future occasions Parliamentary committees, on granting permission to make a railway station, should consider more seriously whether there was room for the traffic inside it. The reason why there was this abortion at Charing-cross was that Parliament allowed the South-eastern Railway Company to come over the river and make a railway station where there was not sufficient room between the river and the Strand, and the consequence was they had to build the station partly over the river, and thus the Embankment was disfigured. He remembered when the engineer was spoken to about the hideous character of the structure, he said: "Wait till you see Cannon-street." He thought some allusion would have been made to the exhibition at Grafton Gallery of

the advertisements which were so common and delightful in the streets of Paris. He quite agreed that there was something in colour which tended to brighten up the prospect, and he did not like to see London with no relief to the dull miserable costume of ordinary life; but let the colour be used with some sense of harmony. Things were much better in Paris. Even the advertisements in the streets had a much better appearance than ours; one reason being that the authorities did not allow any advertisements in white. There was no white in nature and artists were always thankful to be without it. In Paris only Government and municipal advertisements were in white—all the rest were in colour, and that at once made a great difference. Besides that, the French possessed an innate sense of beauty and colour, and that also produced its effect. It would be useless to attempt to suppress advertisements, but they might be regulated.

Mr. FLETCHER MOULTON, Q.C., F.R.S., said he disagreed with a great deal that had been said, though he had no doubt the Society for the Regulation of Advertisements had a good aim, and would do good work when they settled down to it practically. He should like to ask those who took such extreme views whether they could tell him of a single building in London in which posters were put on any part that was architecturally valuable. You might go along the streets for hundreds of miles, and only find posters put on erections which were hideous in themselves, such as hoardings or dead ends of houses. If there was a place in the world which was free from disfigurement by bills, it was the Thames Embankment. There were certain sites which, to the great loss of London, had been unoccupied for many years, but that was because the terms which were rightly asked for their occupation required buildings of a certain importance being put up, and such were not always needed, or there was not money enough to erect them. When surrounded by hoardings, no doubt bills were put on them, but he would rather see a hoarding with posters than without. Take any of the large arteries of London: wherever there was a neglected corner you saw bills; but the fault was with the neglected corner; and he had again and again seen in London posters, which were very far from ugly, and which did a great deal to brighten the streets. It was suggested that they were very far behind Paris; but he knew Paris pretty well, and he could not agree in that view. He could not recall anything in Paris which showed any superiority to London. The *Petit Journal* was advertised all over Paris nearly as badly as some patent medicines were advertised over New York. The taste of the one city was not superior to that of the other. In both cases artistic advertisements were rare, but, on the other hand, advertisements properly used were very useful. He did not believe anything would be gained by adopting the view that cities were to be kept in

cotton, and not to be used for what were believed to be the wants of the people. Good taste was gradually getting the upper hand in all sorts of things, and it had saved all prominent buildings from disfigurement by advertisements. That advertisements were pushed by some firms to an extent that made people loathe anything with their names was perfectly true; that was the abuse; but he did not think anyone who really appreciated what the lives of the people were in London would think that it would do good to anybody to wage war against all advertisements and posters.

Mr. BARKER took exception to the Chairman's remark that advertisements should be confined to the papers; in the street advertisements you did not find so many quacks represented as found their way into the papers and periodicals. There were many interests which would be affected if the Chairman's suggestion were adopted and all posters were abolished. Street advertisements were essential to the success of public entertainments of various kinds, including the drama. Hundreds and thousands of people in London found employment in these concerns, and their interests ought to be considered, besides the printing, paper making, ink, and other allied trades, who would all be greatly affected. Many large manufacturing houses owed their position entirely to advertising. It was not a question whether there should be hoardings or not, that was decided by the County Council; it was merely a question whether they should be plain boards or covered with pictures, and he preferred the latter on every ground.

Mr. JOHN LEIGHTON said they must thank Mr. Richardson Evans for his efforts to give them an Utopia in London; and he quite endorsed his remarks about our city. Sixty years since things were plain, perhaps—but not defaced—because we had not the resources, even if we had the will. Science, he was sorry to say, ministered to ugliness, as did sanitation and social science—sewers and pipes were not pretty. It was the Embankment that exposed the ugliness of the Charing-cross station. The quay had enhanced Somerset House, and degraded York Gate, by placing it in a hole. What was wanted was a minister of the fine arts, and he had argued this in the *Times* twenty years since. The centre of Cambridge-circus was vacant, a position that would be greatly enhanced by the fountain, which was out of place in Regent-circus, and where a splash upon the pavement would harm nothing. Piccadilly-place, or rather "Piccadilly-circus" as it was still called, should be utilised for the diversion of the traffic that now encumbered the adjoining streets, the spot being dotted with shelters for protection from rain, shelters that in the hands of a tasteful architect, could be made as ornamental as they would be useful.

Mr. VINCENT (Messrs. Partington and Co.) drew attention to a point which seemed to have been

lost sight of, viz., that all hoardings used for advertising purposes were rated at their full value, and thus contributed very substantially to local revenues. Again, the firm he represented employed a large number of men in what would be called unskilled labour, who would otherwise be out of work. Bills were not posted in any way so as to interfere with architectural features, or on buildings at all, but only on hoardings erected while buildings were in course of demolition or erection. There was, however, a good deal of what he might call illegitimate bill-posting by persons who were not so particular, and his firm and other large contractors had several times sent deputations to the local authorities to protest against it as a great abuse. He thought the large contractors bore a good record in comparison. During the last few years, they had raised the tone of the advertisements themselves, and both printing and posting had shown a more artistic character. Artists of great reputation had not disdained to produce designs for advertising purposes, receiving large sums of money for the same. If street advertising were prohibited, it would be unfair to a very large industry; in fact, to a great many industries, which were more or less directly connected with it.

Mr. RICHMOND, in reply, said his society disclaimed the paternity of the Bill which the Chairman had mentioned, which was brought in by a private member, and went a great deal farther than the society suggested. A Bill had been drafted, which was still under the consideration of the legal sub-committee, and anyone interested could obtain a copy. Mr. Caine's Bill proposed to inflict a penalty on every hoarding in an agricultural district, which was more than they could expect at present. They did not desire to prevent people in business advertising on their own premises altogether, but only to limit the size of the letters used. The question of sandwich men, again, was a very large one, and humanity was deeply concerned in it. In regard to the argument about depriving men of employment, he might refer to one of the society's publications, where it was pointed out that if less money were spent in bill sticking, it would be used in employing the same men to do something which was more useful to the community; and if any temporary loss were suffered during the change, the members of the Society would be at least as ready with sympathy and help as the men's present employers, for there was no doubt that if a machine were invented by which bills could be posted more cheaply than by manual labour, there would be no hesitation about reducing the staff; it would be only business to do so as to bill-posting, where there was no law there could be no illegitimacy; it was simply a question of the big men swallowing the small ones. He did not see much artistic character in the posters of London, but that might be matter of taste. Mr. Moulton said there were no bills placed on parts of buildings which were of

architectural interest, but the whole of a building was of architectural interest, and anything placed on one part affected the whole. Many houses in the Strand and Fleet-street were covered from top to bottom with advertisements, and entirely disfigured by the large letters put on them. It was not likely, of course, that people would allow bills to be posted on their houses, though theatres, which were public buildings, were considerably disfigured in that way. Besides, it was not necessary to actually post bills on Westminster Abbey in order to injure its architectural effect; if you allowed a hoarding to be put up in St. Margaret's Church-yard, and covered that, it would be almost as bad. The large posters round St. Paul's did not improve its appearance. There was an old print of Ludgate-hill with St. Paul's at the top, dated about 1780, and it compared very favourably with the Ludgate-hill of the present day. There was a repose and decency about it which was now entirely wanting. He admitted that quack advertisements were more rife in newspapers than on the walls, but that seemed to show that they reached the eyes of the people to whom they were addressed.

The CHAIRMAN then moved a vote of thanks to Mr. Evans for preparing the paper, and to Mr. Richmond for reading it, which was carried unanimously.

Miscellaneous.

SANTIAGO EXHIBITION OF MINING AND METALLURGY, 1894.

Information respecting an Exhibition of mining and metallurgy, to be opened in the Quinta Normal de Agricultura, Santiago, in the second fortnight of April, 1894, has been received from the Foreign-office through the Science and Art Department.

The Exhibition will be divided into the following sections:—

SECTION I.

Motive Power.—(a) Steam, petroleum, and gas-engines; (b) Pelton wheels or similar apparatus for utilising small quantities of water from a great height.

SECTION II.

Electricity.—(a) Dynamos for transmission of mechanical force for lighting and for electrolysis; (b) electromotors and electric winches; (c) electric drills; (d) pails for electrolysis and the materials employed in its preparation; (e) pumps and special injectors to move electrolytes.

SECTION III.

Mining Machinery.—(a) Winding machinery; (b) air compressors; (c) drills worked by com-

pressed air; (d) boring machines; (e) mining pumps; (f) tools and accessories used in mines—ventilating apparatus, life saving ditto, lamps, &c.; (g) strong explosives for mining purposes; (h) apparatus for the conveyance and loading of minerals; aerial tramways, portable railways, &c.

SECTION IV.

Mechanical Preparation of Minerals.—(a) Crushing and pulverising machines; (b) concentrating machines, by means of air and by means of water.

SECTIONS V.

Metallurgy.—(a) Smelting, calcining, and roasting furnaces; (b) metallurgical and industrial treatment of copper, zinc, lead, and tin; (c) small installations for the hydrometallurgical treatment of copper; (d) small installations for the treatment of gold ore by cyanide of potassium, by mercury, &c.; (e) methods of lixiviation.

SECTION VI.

Chemical Industries.—(a) manufacture of sulphuric acid, Barbier apparatus, &c.; (b) apparatus used in the extraction of nitrate, other salts and iodine; (c) laboratory utensils and reagents.

SECTION VII.

Statistics and Plans.—(a) scientific instruments used in mining; (b) plans; (c) models; (d) catalogues; (e) statistical data.

SECTION VIII.

Mining and Metallurgical Products.—(a) Collections or samples of rocks, minerals, ornamental rocks, hard rocks, refractory materials, earths and clays, miscellaneous mineral products, native sulphur, rock salt, salt from salt springs; (b) mineral and vegetable fuel, coals, residuums and agglomerates, asphalt, and asphaltic rocks, pitch, mineral tar, raw petroleum; (c) ores in the rough, copper, lead, silver, zinc, &c.; (d) products obtained from ores in the rough.

There will be three classes of awards, which will consist of first, second, and third class medals, which will be accompanied with diplomas signed by the Minister of Industry and Public Works, and by the President and the Secretary of the Sociedad Nacional de Minería (National Mining Society).

Each jury will be composed of three Chilians and two foreigners, and will be presided over by one of the members who shall be elected by a majority of votes.

The organisation of the Exhibition is confided to the Directorate of the Sociedad Nacional de Minería, which will be presided over by the Minister of Industry and Public Works whenever this functionary attends its meetings.

Exhibits are invited from foreign nations and applications for space may be made to the Chilian Legation in London.

The exhibits must be in Valparaiso or Santiago not later than March 15, 1894.

The Directorate oblige themselves to pay the freight out and back again, by sea and land of the exhibits; and also the passage money out and back again of the workmen and operatives brought out for the installation and running of the exhibits.

Exhibitors will defray the cost of installation of their exhibits, but the Directorate will provide tables and show cases for collections, plans and instruments.

The Directorate will provide motive power for the machinery and apparatus, and the minerals for experimental trials.

LYONS EXHIBITION OF 1894.

This Exhibition, which is to be universal, international, and colonial, is made official by a decree of President Carnot, endorsing the reports of the Rhône Departmental Council, the Chamber of Commerce, and the Conseil d'Hygiène of Lyons, and approving the concession of the enterprise to E. J. Claret. The Exhibition is announced to open in the Parc de la Tête d'Or, belonging to the Lyons Municipality, on 26th April next, and to remain open until the end of October. During the period of the Exhibition, Congresses will be held on questions related to pure and applied science, art, industry, and social economy, and also competitions of various kinds. The space roofed over will be at least 50,000 square metres. The Exhibition buildings will constitute an *entrepôt*, so that the exhibits will be free from customs and *octroi* duty, and no drawing or reproduction of an exhibit without the exhibitor's consent will be permitted. All exhibitors, whether French or foreign, can obtain a certificate, which will confer the same protection of an invention as a patent, or of a design as registration. Group II. of the classification is devoted to social economy. Group IV. to education and instruction, with the materials and processes of the liberal arts, class 10 bearing upon the usual applications of drawing and modelling, class 11, on photography, class 12, on music, and class 14, on scientific instruments. Group V. includes textile fabrics and clothing. Group VI. furniture and accessories, class 25 being restricted to non-electrical methods of lighting and heating. Group VII. embraces raw and manufactured products of the extractive industries. Group VIII., the plant and processes of the mechanical and electrical industries, class 34 including electricity and its applications, and class 45 workmen's productions. Group IX. is devoted to elementary products, and group X., to agriculture, horticulture, viticulture, and pisciculture. Further information may be obtained from M. J. Claret, Palais St. Pierre, Lyons.

THE VILLAGE LEATHER INDUSTRY IN RUSSIA.

The leather industry is one of the most important in Russia, the production being very large and the

trade widely spread among the inhabitants. Statistics show that tanning is carried on as a village industry in 44 Governments, occupying about 9,500 households, or about 21,000 men, and that the annual production amounts to 12,000,000 roubles, or about 28 per cent. of that of the factories. The production of wrought leather is spread over 40 Governments, and occupies 85,000 men, the annual production being about 26,000,000 roubles. The Russian Minister of Finance has recently issued a report upon Russian industries, in which it is stated that the large manufactories do not compete to any great extent in this branch of trade, consisting principally of boots and shoes, chamois goods, harness and other kinds of wrought leather. A large number of men are also employed in tanning sheepskins used for clothing in the various villages. The value of the annual production of these articles is estimated at 20,000,000 roubles, or about ten times that of the manufactories. It is not known at what precise date the village tanning industry originated; but there is no doubt it existed in this form long before it became a regular manufacturing enterprise. The landowners rendered some assistance towards developing the industry, as it was their custom to apprentice some of their peasants to some form of trade, these young men on their return home, practicing their trade on their master's estate. The leather industry is carried on with some difficulty in the various villages, owing to want of capital, insufficient knowledge and difficulties in procuring raw material and in disposing of their goods. The villagers purchase their raw material in the villages and bazaars, or from special middlemen. It is also a matter of difficulty for them to acquire the necessary materials for dressing the hides as they are generally unable to procure bark directly from those who collect it, and are obliged to buy it from the middlemen. The methods practised by the cottagers are very simple, even crude and primitive. They have rarely a workshop, but content themselves with the cottage which they occupy with their families. The vat used for steeping and tanning the hides is placed in the street, and the hides are kneaded and greased at home. Their instruments are also very imperfect. The work is generally carried on by the members of the family, and only the more well to do peasants hire workmen, and these generally live with the family, receiving wages which vary greatly, according to the locality, from 15 kopecks in the Viatka district, to 60 kopecks per day (100 kopecks = 3s. 2d.) in the Vasilsk district of the Government of Nijni-Novgorod, their food being provided. In some places, as for instance, in the Chernigov district, the peasants club together to buy materials, and work in common. The tanning process lasts but three months in the government of Tver, and from six weeks to two months in the district of Chernigov. The principal consumers are the peasants themselves who are not very exacting in their choice. The profits accruing

from this trade cannot be regarded as very large. In the Viatka district they amount to about 5 or 6 per cent. clear profit of their gross receipts. The highest profits are realized by those who do piece work for the large manufactories, hides and materials all being found. In the government of Moscow a cottager assisted by a family of three persons will dress hides to the value of 1,800 roubles a year, and make a profit of about 13 per cent. Tanning is carried on as a village industry in the government of Saratov, Perm, Kazan, Penza, Tver, Poltava, Chernigov, Viatka, and in the Terskoi and Kuban districts of the Caucasus. The extent of the trade varies greatly in the above mentioned localities; thus, for instance, in the government of Saratov there are 240 tanners; in the colonies of the Kamyshinsk district there are 165, while in the government of Perm there are 500 village tanners, with a yearly production amounting to 200,000 roubles. In the government of Viatka, although the trade has been of late years developing into a manufacturing industry, the village tanners produce leather goods to the value of 4,000,000 roubles a year. The Russian government and private institutions, recognising the importance of developing, improving, and strengthening the village industries of Russia, have continually studied this question, and have taken steps to encourage and develop the village handicrafts.

Correspondence.

THE HORSE FROM AN ARTISTIC POINT OF VIEW.

I was sorry not to have been able to stay for the discussion on Captain Hayes's very able paper on the artistic anatomy of the horse. He seemed a little severe upon artists, partly because they do not always depict the movement of a horse as it is shown by the camera, and, also, because the proportions given to the horse often do not tally with those shown by actual measurement. To support the former criticism Captain Hayes showed us a photograph of a horse cantering, but it looked so little like this action that a number of the audience asked what it was doing. A picture surely represents nature as it appears to the eye under the ordinary condition of sight, and the power of observing of each individual is in accordance with the training received and the intelligence. The artist, to be successful in selling, has to paint to the standard reached by his patrons, but not to that he and his fellow artists attain, and still less to that of an instrument which is quicker than the best trained eye can possibly become. In spite of the records of the camera, the ultimate success of a drawing depends upon its looking right. As to the second criticism, it may be true that a horse's head, in very many cases, measures $2\frac{1}{2}$ times into its

body, but there must be exceptions to this rule; and we have the authority of the sculptors of ancient Greece to support the view, that it is in accordance with the laws of beauty to select examples when the head is small in proportion to the body.

T. R. ABLETT.

Nov. 28, 1893.

General Notes.

VIENNA EXHIBITION, 1894.—The Department of Science and Art has received through the Foreign Office, a despatch from the Austro-Hungarian Ambassador calling attention to an Exhibition to be held at Vienna, dealing with the subjects of cheap food or the people, the sustenance and equipment of the Army, &c., joined to a special Sport Exhibition, and requesting that the municipalities of the most important towns in this country which are interested in these questions may be invited to take part in the Exhibition. The Exhibition is a private undertaking, but supported by the Austro-Hungarian Government, who have placed the Rotunda at the disposal of the management, and by the Imperial and Royal Minister of Commerce accepting the honorary presidency.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

DECEMBER 6.—“An Artist's View of Chicago and the World's Fair.” By FREDERIC VILLIERS.

DECEMBER 13.—“Carriage-way Pavements for large Cities.” By LEWIS H. ISAACS. SIR BENJAMIN BAKER, K.C.M.G., F.R.S., will preside.

Papers for meetings after Christmas:—

“London Coal Gas and its Enrichment.” By PROF. VIVIAN LEWES.

“Automatic Balance of Reciprocating Machinery, and the Prevention of Vibration.” By W. WORBY BEAUMONT.

“Experiments in Aeronautics.” By HIRAM S. MAXIM.

“Automatic Gem and Gold Separator.” By WILLIAM S. LOCKHART.

“The St. Pancras Electric Light Installation.” By HENRY ROBINSON, M.Inst.C.E.

“Electric Signalling without Wires.” By WM. HENRY PREECE, F.R.S.

“Modern Development of Illustrated Journalism.” By HORACE TOWNSEND.

“The Adam Architecture in London.” By PERCY FITZGERALD.

“Pewter.” By J. STARKIE GARDNER.

“Railway Extension in India.” By JOSEPH WALTON.

“The Petroleum Fields of India: their Present and Future.” By R. D. OLDHAM.

“Indian Currency.” By J. BARR ROBERTSON.

“Telegraphic Communication between England and India: its present Condition and Future Developments.” By E. O. WALKER, M.Inst.C.E., C.I.E.

“Chota Nagpore: its Mineral Wealth and its Industrial Resources, and its value to India.” By J. F. HEWITT.

“The Water Supply and Sanitation of the North-Western Provinces and Oudh.” By SIR AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieutenant-Governor of the North-Western Provinces and Oudh.

“The Forthcoming Antwerp Exhibition.” By EDOUARD SÈVE.

“Morocco.” By Captain ROLLESTON.

“Paraguay.” By A. F. BAILLIE.

INDIAN SECTION.

The meetings of this Section will take place on the following Thursday Afternoons, at Half-past Four o'clock:—

January 18; February 15; March 8; April 5, 26 May 24.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on the following Tuesdays, at Half-past Four or Eight o'clock:—

January 23; February 20; March 6; April 17; May 1, 29.

APPLIED ART SECTION.

The meetings of this Section will take place on the following Tuesday Evenings, at Eight o'clock:—

January 30; February 13, 27; March 13; April 10; May 8.

CANTOR LECTURES.

The following courses of Cantor lectures will be delivered on Monday Evenings, at Eight o'clock:—

HENRY BLACKBURN, “The Art of Book and Newspaper Illustration.” Three Lectures.

LECTURE II.—DECEMBER 4.—*The Engraver.*—The various methods of reproducing drawings and photographs for the press—The substitution of photographic and mechanical engraving for handwork—Specimens of the newest processes of illustration.

LECTURE III.—DECEMBER 11.—*The Author*.—His part in the illustration of books—His handwriting—The decorative page—Examples of illustration—Archaic decorative, topical—The Book of the Past—The Book of the Future.

PROFESSOR FRANK CLOWES, D.Sc., "The Detection and Measurement of Inflammable Gas and Vapour in the Air." Four Lectures.

January 22, 29; February 5, 12.

HUGH STANNUS, F.R.I.B.A., "The Decorative Treatment of Traditional Foliage." Four Lectures.

February 19, 26; March 5, 12.

CAPTAIN W. DE W. ABNEY, C.B., F.R.S., "Photometry." Three Lectures.

April 2, 9, 16.

HENRY CHARLES JENKINS, A.M.Inst.C.E., "Typewriting Machines." Two Lectures.

April 30; May 7.

JUVENILE LECTURES.

Two lectures, suitable for a juvenile audience, will be delivered by WALTER GARDINER, M.A., F.R.S., on "Plants: their Foes and Defences," on Wednesday evenings, January 3 and 10, 1894, at 7 p.m.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 4 ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Henry Blackburn, "The Art of Book and Newspaper Illustration." (Lecture II.)
Farmers' Club, Salisbury-square Hotel, Fleet-street, E.C., 4 p.m. Mr. G. B. L. Druce, "The Report of the Labour Commission, so far as it affects the Agricultural Labourer."
Royal Institution, Albemarle-street, W., 3 p.m. General Monthly Meeting.
Engineers, Town hall, Westminster, S.W., 7½ p.m. Mr. Perry F. Nursey, "Some Practical Examples of Blasting."
Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Discussion on Mr. H. G. Watel's paper, "Application of Air in Motion to Chemical Industry." 2. Mr. H. Harris, "Note on the Copper Mines of Singhbhoom," 3. Mr. Chapman Jones, "The Product of the Action of Mercuric Chloride upon Metallic Silver."
Imperial Institute, South Kensington, 8½ p.m. Dr. R. Bowdler Sharpe, "The Lost Continent and its Bird Life."
Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. R. Godfrey, "The Local Government Bill, 1893" (generally known as "The Parish Councils Bill").
British Architects, 9, Conduit-street, W., 8 p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. Dr. Schofield, "Habit in Man."
London Institution, Finsbury-circus, E.C., 5 p.m. Prof. C. V. Boys, "When and Why an Electric Spark Oscillates."
TUESDAY, DEC. 5...Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion upon the papers on

"Impounding-Reservoirs in India, and the Design of Masonry Dams," by Mr. Clerke, Mr. Sadasewjee, Colonel Jacob, and Professor Kreuter.
Pathological, 20, Hanover-square, W., 8½ p.m.
Biblical Archaeology, 37, Great Russell-street, W.C., 8 p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. F. E. Beddard, "The Geographical Distribution of Earthworms." 2. Mr. C. J. Gahan, "A Collection of Coleoptera sent by Mr. H. H. Johnston, C.B., from British Central Africa." 3. Captain F. W. Hutton, "A Collection of Petrels from the Kermadec Islands."

WEDNESDAY, DEC. 6...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Frederic Villiers, "An Artist's View of Chicago and the World's Fair."

Geological, Burlington-house, W., 8 p.m.
Entomological, 11, Chandos-street, W., 7 p.m. 1. Mr. George T. Bethune-Baker, "A Collection of Lepidoptera from Egypt." 2. Mr. Walter F. H. Blandford, "The Rhynchophorous Coleoptera of Japan.—Part III. Scolytidae."

Archæological Association, 32, Sackville-street, W., 8 p.m.

Obstetrical, 20, Hanover-square, W., 8 p.m.

National Indian Association (Indian Conference-room), Imperial Institute, South Kensington, 4½ p.m. Sir Roland K. Wilson, "Akbar, the Great Mogul."

Central Chamber of Agriculture (at the House of the Society of Arts), 11½ a.m. Annual Meeting.
Inventors' Institute, 27, Chancery-lane, W.C., 8 p.m.

THURSDAY, DEC. 7...Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Linnean, Burlington-house, W., 8 p.m. 1. Mr. W. F. Kirby, "Catalogue of the described *Neuroptera Odonata* (Dragon Flies) of Ceylon, with Description of New Species." 2. Signor U. Martelli, "The Cause of the Fall of the Corolla in *Verbascum*."

Chemical, Burlington-house, W., 8 p.m. 1. Ballot for the Election of Fellows. 2. Mr. D. Truman, "An Apparatus for the Estimation of Gases Dissolved in Water." 3. Mr. R. M. Decley, "Metallic Oxides and the Periodic Law."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. Alfred Austin, "The Essentials of Great Poetry."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Annual General Meeting. 2. Reception of the Annual Report of the Council, and the Election of Council and Officers for the year 1894. 3. Discussion on Professor George Forbes's paper, "The Electrical Transmission of Power from the Niagara Falls."

Imperial Institute, South Kensington, W., 4½ p.m. The Earl of Jersey, "New South Wales."

FRIDAY, DEC. 8...Sanitary Institute, Parkes Museum of Hygiene, 74A, Margaret-street, W., 8 p.m. Prof. T. Oliver, "Metallic Poisons—Lead and Arsenic."
Astronomical, Burlington-house, 8 p.m.
Philological, University College, W.C., 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.
Physical, Science Schools, South Kensington, S.W., 5 p.m. 1. Mr. J. Swinburne, "A Potentiometer for Alternating Currents." 2. Mr. W. H. Preece, "The Specific Resistance of Sea-water." 3. Prof. G. M. Minchin, "The Co-efficient of Self-Induction of a Circular Current and the Field of a Cylindrical Coil."

SATURDAY, DEC. 9...Botanic, Inner-circle, Regent's-park, N.W., 3¼ p.m.

Journal of the Society of Arts.

No. 2,142. VOL. XLII.

FRIDAY, DECEMBER 8, 1893.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

Mr. HENRY BLACKBURN delivered the second lecture of his course on "The Art of Book and Newspaper Illustration," on Monday evening, 4th inst.

The lectures will be printed in the *Journal* during the Christmas recess.

Proceedings of the Society.

FOURTH ORDINARY MEETING.

Wednesday, December 6, 1893; Sir GEORGE HAYTER CHUBB, Member of the Council, in the chair.

The following candidates were proposed for election as members of the Society :—

- Baines, Jervoise Athelstane, 32, Kensington-park-gardens, W.
- Crowdson, Wilson, The Barons, Reigate, Surrey.
- Master, John Henry, Montrose-house, Petersham, Surrey.
- Pomeroy, Frederick William, 1, Wentworth-studios, Manresa-road, King's-road, S.W.
- Sell, Henry, Purley, Surrey.
- Wedderburn, Sir William, Bart., M.P., 84, Palace-chambers, S.W.
- Whichelo, Matthew Anthony, Clydesdale, Bycullah-park, Enfield.
- White-Cooper, Alfred S. P., M.A., 49, Cornwall-gardens, S.W.

The following candidates were balloted for and duly elected members of the Society :—

- Batley, William, care of Messrs. C. E. Clifford and Co., 200, Piccadilly, W., and 5, St. George's-road, S.W.

- Broughton, Urban H., Chicago, Illinois, U.S.A.
- Dadd, Frank, Wilton-house, Hyde-vale, Blackheath, S.E.
- Edis, Colonel Robert W., 14, Fitzroy-square, N.W.
- Geflowski, E. Edward, 5, Stratford-studios, Kensington, W.
- Hodson, Frederic Walter, Loughborough, Leicestershire, and Abbey-buildings, Westminster, S.W.
- Ogden, Charles Edwin, 155, Aldersgate-street, E.C.
- Rainey, William, R.I., Fishbourne, Chichester, Sussex.
- Stewart, David, M.A. (Lord Provost of Aberdeen), Banchory, Kincardineshire.
- Willett, William, Hatfield-house, Mill-hill-park, W.

Mr. FREDERICK VILLIERS delivered the following lecture :—

AN ARTIST'S VIEW OF CHICAGO AND THE WORLD'S FAIR.

By FREDERICK VILLIERS.

I must say that I feel rather diffident in addressing you on the subject of Chicago and the World's Fair, for you have already heard so much on the subject in this hall from the Chairman of Council, Sir Richard Webster, and Mr. James Dredge. I therefore hope that if you find in my address that I somewhat trench on what these gentlemen have already told you, that you will forgive me, as it is almost impossible not to do so under the circumstances. There is also another matter I wish to open my heart to you about: the title of my lecture which I sent into this Society is not the one that I see printed before me; my title, I think, naturally is a much better one, "a vagrant artist in Chicago." Now, all of you, of course, know that there are two distinct meanings to the word "vagrant," as an adjective it means unsettled, moving about, without any certain direction. As a substantive it is quite a different thing, an idle wanderer, a vagabond, a sturdy beggar. It is unnecessary for me to say, that it is the adjective sense that I want you to take that title this evening—"a vagrant artist" and not "an artistic vagrant," and in a purely vagrant sense with your permission, we will move in the vicinity of Chicago and the World's Fair. I also wish to tell you that all these pictures, which number some 120, with the exception of three have been taken by me with a small hand camera, a No. 3 Kodak. There are a few sketches, rough ones from my own pencil, but I hope they may prove interesting.

Last April I was invited by *Black and White* to go to Chicago and do the Exhibition. I looked forward to my journey with great interest, for I had seen many European and Colonial Exhibitions, but this American show was expected to "beat creation." I also felt a personal interest in the "World's Fair." I know America well. In the fall of 1890 I was there, and the burning question throughout the country was, "Where will the Fair be held?" The Eastern States were advocating their respective capitals, and in New York the feeling ran high in favour of their own city. I almost got myself disliked in the clubs of the capital when I advocated far-distant Chicago; the reason for my choice was that Chicago was the central city of the United States. To get to it one must travel through some thousands of miles throughout the finest parts of the States and see some of the fine inland cities, but all characteristic of the extraordinary energy, and the pluck of that wonderful medley of nationalities—the citizens of the United States. It was an opportunity for European visitors to see America, and of the Americans at home to re-visit the inter-oceanic city on Lake Michigan. It was, therefore, a quiet little triumph for me when Chicago was hit upon as a site for what has become the greatest Exposition the world has ever seen. With your permission, I will take you there as soon as possible.

Of the many routes from New York to the World's Fair there are two which show the most diversified scenery, the Pennsylvania Railroad, and the New York Central. By the former route you touch Philadelphia, and then you pass through 700 miles of most delightful scenery resembling our picturesque Surrey and the occasional grandeur of the Trosachs. By either route, within twenty-four hours, one can reach the inter-oceanic city, a distance of 1,000 miles from the coast.

Before we go to the Exhibition we will take a glimpse at Chicago city. A glimpse will certainly suffice. Much has been said of Chicago, especially by the citizens themselves, but Chicago is certainly a most remarkable place. In 1801, only a few huts on the swampy shores of Lake Michigan, in which a few whites lived and traded with the Indians, marked the city of Chicago of to-day. In 1811, a military post was stationed there, a fort called Dearborn, to protect the white trading camp. Ten years later this military post consisting of 100 officers and men was attacked

by Indians. The soldiers, their wives and children in Fort Dearborn were all massacred and the little trading station was entirely wiped out. After many years the traders returned to the historical spot on the shores of Lake Michigan, and in 1831 there was a village of twelve houses. A decade later it became an incorporated city of nearly 6,000 souls. In 1851 it was rapidly becoming a city of commercial importance; 35,000 people were now inhabiting the place. Twenty years after found it the most prosperous city in the Western States, with over 1,000,000 residents. On Sunday evening, on the 8th October, in the year 1871, a small fire commenced at the south-east of the city, a strong south-west wind fanned the small fire into a sea of flame; in six hours Chicago was practically laid in ashes, $3\frac{1}{2}$ square miles of houses swept away, 100,000 people made homeless, and 200 were burned to death. Within twelve months Chicago raised her head above the ashes. To-day the phoenix city has a population of 1,400,000 people; half the total network of railways affect her commerce more or less directly; she is the converging point of 35,000 miles of railway; there are seven terminal depôts within the city. Chicago is the main centre of the vast trade carried on from the chain of inland seas which gives her direct waterway to the Atlantic. The Chicago river is covered by 61 bridges, the majority of which are turning bridges, allowing the passage of ships up and down the river. Under this river there are many tunnels to remove the pressure of the street traffic. The city is gridironed with tram tracks covering nearly 4,000 miles of streets.

On arriving at Chicago one is impressed at once by the immensity of her buildings. Here is one. In a short time one is impressed by the monotony of them. This is characteristically called a "sky scraper." There is nothing beautiful, artistic, or worthy of being imitated by us or any other nation in these sky scrapers. There seems to be no municipal restriction in Chicago on the eccentric genius of her architects. These buildings run high, cost millions, and look ugly. The famous Auditorium Hotel and Theatre at night look like a Manchester cotton mill with all hands busy.

This is the Masonic Temple. That building is 265 ft. high, and is divided into 24 storeys. A special form of construction is required for all these elevated buildings, for the soil of Chicago is a series of strata and liquid mud

and clay to a distance of 60 ft. In the early days buildings were founded on piles driven through the mud to the solid strata below. Now they are founded on bearings placed on the upper crust of the clay, which is 14 ft. from the surface of sand. The bearings consist of steel bars, almost close together, with the interstices fitted close with cement. Therefore, the city is unique in the world, for it is practically a floating city, paradoxically stranded on the shores of Lake Michigan. There is no busier city in the universe; Chicago never rests, her sleep is always feverish; even in the small hours of the morning, when one thinks she is at rest, the quick throbbing of the great pulse of the great city of the world—the underground cable-tramway—is always perceptible. Her people—I mean the beings one must necessarily brush against in a busy place (I am now talking, not of the people of America, but the ordinary people of Chicago city)—the people are in one sense unlike the buildings which overshadow them for they are certainly not monotonous.

There were more than 140 new hotels in the vicinity of the World's Fair grounds when I was there, from the tall eight-storey building to the two storey affair. Probably about one-third were permanent structures, the rest were what were called "frame houses." This is a frame house. The first-class hotels were equipped as most hotels usually are. More of the second were furnished with the business-like idea of six months' profitable use and the disposal of the material to the best advantage at the end of that time. The third and more humble were furnished with the idea of six months' wear and tear, and the hope that at the end of that period a fire and an insurance company would do the rest. The speed with which some of these hotels were run up was marvellous, and a compliment to Chicago push and enterprise. The most conspicuous example of this was the hotel Lamont. It was gutted by fire whilst I was there. At the time the firemen were carrying charcoal out of the rear, the upholsterers were carrying in carpets at the front.

There is one day in Chicago, in fact in America altogether—the United States—which is called Decoration Day, and on this day in Chicago the almighty dollar seems to be forgotten for a time. This function shows a fine trait of sentiment in the breasts of our American cousins; the surviving comrades of those who fell in the late civil war, millionaires

and paupers, wend their way to the various cemeteries in each State and decorate the graves of the dead. After this is done they rally on certain centres in the city, and then parade through the streets. Now I was in Chicago during this function, and with your permission I will show you a few snap-shots I took of the Grand Army of the Republic.

Last Decoration Day there happened to be a British Military Tournament performing in the city of Chicago, so the British soldiers, with great good feeling, did honour to the American dead by parading with the rest of the troops. I will show off a few snap shots I took of the British in Chicago. I think they are interesting, because I think it is the first instance when British troops have been seen in American streets since the Americans told us to quit their country a few years ago. These are British lifeguards. Some artillery, with a typical American, or at least a Chicago crowd. They are inquisitive, and they came much nearer to the horses than we do in this country. There are some British grenadiers, and the highlanders you see on the right of the picture.

Before I leave Chicago city, I wish to draw your attention to the postal boxes. Now, postal boxes in all American cities are mostly attached to lamp-posts. It is a novel sight to an Englishman, and, at first, seems to speak of sweet trustfulness in American character, when one sees a pile of papers rolled and stamped for posting placed simply on the top of these pillar-boxes.

A few wealthy gentlemen of that city thought that a fine club house immediately on the lake front would be desirable there for their comfort. The city authorities objected to this scheme as there was a municipal law against building on the frontage of the lake. The Chicago gentlemen held a meeting, the outcome of which was that a ship was built on the lake shore, and when completed she was never launched. In fact, there she is to-day, and she is called the "Argo" Club. A most delightful place it is in summer in the torrid heat of Chicago's hot season, when one can sit on the upper deck, smoke, and gaze over the lake to the city.

We may now take steamer and go by lake to the "World's Fair," or take the Illinois-street Railway from Van Buren-street to the end of Sixtieth-street, a distance of seven miles from Chicago city.

We will enter the Fair grounds through

the Midway Plaisance, the strip of land which joins Jackson and Washington-parks, about a mile in length and about 300 feet wide, and on which we see the side shows of the World's Fair, shows which surpassed in every way the famous Street of Nations in the Paris Exhibition. We will take them in their proper order. On the immediate right of the midway was the Beauty Show. The ladies within this shrine of beauty were no doubt selected with great care by the committee, but, to me, the majority were far from lovely.

We next come to old Ireland, but *en route* we pass a few gentlemen from Dahomey who are carrying their chief home, who is a Frenchman, after a heavy luncheon. Ireland was represented by two villages—that of the Countess of Aberdeen, and that of Mrs. Ernest Hart. The latter lady's village was perhaps the most picturesque, so I give it here. It describes a street of typical cottages, market people, and the ruins of Drogheda Castle. A village blacksmith worked beneath the walls of the castle. One entered the exhibit under a gateway, the exact representation of the St. Lawrence gateway at Drogheda. By the market cross a veritable Irish piper droned away on an instrument even less euphonious than the one which I showed you a few moments ago.

Japan came next with a very pretty little kiosk, and then we came to the Javanese village, a large village composed of wicker-work, the huts being thatched with palm leaves. There was a theatre there with a contingent of royal dancers. The inhabitants were very diminutive, the women looked no older than a ten years' old child of this country, but they were beautifully shaped and comely in face.

I saw a charming view of this village through a hole in the wall of a bridge outside the Plaisance; I stuck a camera against the orifice and took a chance shot. Here is the result, overlooking the Javanese village.

Germany showed in the Plaisance as well as she did in the Fair proper. A large village nestled under the walls of the stronghold, and you will see tower, battlements, and draw-bridge. This frowning fortress was gentle enough within its walls, for there was a restaurant, a museum, and a beer garden.

I know my Cairo well, but I must say, after what I saw at Chicago, that I think that Cairo must be entirely stripped of its old lattice work, for it seemed to be all there by the shore of Lake Michigan, in fact, only the walls were artificial;

the doors and woodwork were veritable relics of the past. This is the entrance to Cairo, and on the left are the ruins of Edfoo. Here is a street in the very fine side-show. The shopkeepers, camel and donkey boys, dancing girls, donkeys and camels were all in the Midway Plaisance. Here are some donkey boys.

But enough of the East for a time. We will walk over and look at the wonders of the Western engineering school, the great Ferris wheel. This roundabout was in the centre of the Plaisance and measured 253 feet in height and 785 feet in circumference. The spokes were like cobwebs, after the fashion of the latest bicycles, yet the slender tyres carried round 36 cars. A friend of mine remarked, "Why, sir, by the time you have been round this stupendous circumference in company with nearly 2,000 of your fellow creatures you are ready to say that is all but as big as the earth." From one of the cars you could get a fine view of the Midway Plaisance.

We will now walk over to the captive balloon and soar a little higher. From the end of the lower balloon one can view the whole of the Exhibition grounds. Descending to earth once more, we will cross the Plaisance into old Vienna. Austria was well represented with a continuous square of antique houses and shops. In the centre of the square was a band stand and a beer garden. This probably, next to Cairo, was the most picturesque side show of the Exhibition. Further on, on the same side of the Plaisance, was a model of Rome, with real Papal guards doing duty at the gates, and all the guards were Irishmen. There Stamboul stands up against the blue sky, and here there was a bazaar loaded with spoils of the Sublime Porte; and I will now show you the exterior of the theatre, with a remarkable Midway Plaisance crowd waiting to go in to see the dancing girls. By the door of the bazaar you will see the chair porters, with their sedans. At sunrise, noon, and sunset, a real muezzin in the minaret calls all good Mussulmans to prayer. In the early days they left their shoes outside the place of worship, which is the custom in their own country. But this did not continue for long. Visitors to the Plaisance misunderstood this custom, and carried the shoes off as a kind of relics.

All the *cafés* and restaurants in the World's Fair ground started with exorbitant prices. The rates so scared the visitors that they brought their luncheons with them.

I will now show you the subjects which

presented themselves about mid-day to the man with the kodak. They are beautifully unconscious of a snap-shot being near. Here is another snap-shot, and you will see the people are just starting their lunch, and the next one will show you them engaged in eating it.

This was probably the most famous *café* in the ground. It is called the "Marine." You see the architecture of this *café* is quaint; the roof is all points. In this *café* the *menu* consisted of soft-shell crab, broiled lobsters, clams, and other things. Clams are scarcely known in this country, but in America they are eaten raw, fried, made into soup, and also baked. Small restaurants and kiosks in the ground were devoted to this dish.

Next to the *café* is a pretty little Japanese tea-garden, and further on is the Indian pavilion, where tea was handed to visitors by smart Indian servants, free of cost. In this building, Indian silks, porcelain and glass wares were exhibited and sold. We are now well within the line of State houses. There were over forty of these structures, representing the style of houses in the various States which make up the Union. We will now just look at a few of the buildings. They were mostly used as club houses for visitors from their respective States. Pray observe the ambulance waggon in this view.

[The lecturer then showed a series of views of the various State buildings.]

We will now move along the Lake shore towards the English house. On the right we come to the French representative building. Then to Ceylon, one of the finest buildings erected by aliens. It was built entirely of Ceylon woods; the interior carvings were simply superb. Next to this was the German house; but just now quite a hurricane is blowing off the lake, and the inter-ocean looks very much like a stormy sea. By this stormy sea was Victoria House, the best built, the best upholstered, building in the exhibition. As an American said to me as we looked on the old Elizabethan homestead:—"If you do not build for elegance, I guess you Britishers build to stay."

The warship *Illinois* is anchored on the left flank of the house, showing the American flag, as it always ought to do—floating side by side with the Union Jack. This warship was practically no warship at all, for she was built up from the bottom of the lake and was fast aground, which is the position which most warships in our day seem to come to. The

ship was built of wood and canvas; she had canvas guns and smoke stacks so cunningly contrived and mounted like the real thing, that one expected every moment to see her weigh anchor and steam across the lake, firing, as she went, a salute to the English flag flying from the Victoria-house. We had our policeman exhibited in front of Victoria House—a veritable constable from the Mansion-house—Mr. Atkins.

But you will now ask how about the Exhibition proper. We will go right away, getting on board an electric launch from the landing near the "Clam Bake" restaurant in front of Victoria House, or we will take one of the roller chairs. Now *en route*, as good Britishers, we must take a glance at the State House of Canada, and that of New South Wales. They were, as they ought to be, under the wings of the Mother country, right in front of Victoria House. Regarding the buildings I am now about to show you from the World's Fair proper, I must say that any words of mine can give but a poor idea of the beauty of some of them. I believe it is impossible to describe the remarkable beauty of the scene: beauty all the more remarkable when we remember that about three years ago this very spot was a swampy desert by Lake Michigan.

Of the interior exhibits of the building I will say but very little. Here is an Austrian exhibit in the Fine Arts Building, and this picture will probably give you an idea of the numerous exhibits in the Manufactures Building, a building so large that it could have contained our Exhibition of 1851 within its walls; and it is computed that the whole fighting force of Russia could stand under its roof. The cost was something like £200,000 to build. It always delights the heart of an American to tell you how much a thing costs. I shall be very un-American about other things that I shall show you; but, as this is the biggest structure on the earth, I may perhaps be forgiven for going into details. I may tell you that I had the first offer to buy the building after the Exhibition was over, but, as I have not a large family, I allowed a railway company to take my chance of it, in order to convert it into a terminus.

Now we will take one of these roller chairs, and you will see by the picture that many are disengaged, or, rather, they are occupied by the men who roll them. It was a dull day at the Exhibition when I took this snap-shot.

You can either take a chair or get on board the electric car on the intra-mural railroad.

This view represents the Fisheries Building, in which we were very poorly represented. We will land here and cross over the bridge towards the building, which you will see. The water capacity of the aquarium in this building was 140,000 fathoms. Here the Fine Arts Building now stands up out of the waters. Now we are in the direction of the Illinois Building, and here you see the State House on the left. Now we go to the back of the State House. Still at the back of the State House we at last come to the Fine Arts Building. This building was the only substantial building of all the buildings at the World's Fair, with the exception, probably, of Victoria House. This was a fire-proof building, the walls being of brick, the roof, floors and galleries of iron. Within it our exhibit held its own with any other nationality.

One of the most important buildings was that in which the transportation exhibits were contained. Here is the exterior of the Transportation Building, and in it were interesting articles, including every appliance or structure for carrying purposes, from the balloon to the latest locomotive.

Now we will leave this building to go straight to the grand lagoon. On the left of the picture you may see the peristyle connecting the music hall and the *café* facing Lake Michigan. The central archway opened on the lake from the grand saloon. Each column bore the coat of arms of its state. In front of the archway was the great gilt statue of liberty, which stood out against the dead white and the sky, and though crude was certainly artistic.

Between these two buildings, the casino on the left and the agricultural buildings on the right, you observe through the vista the convent of La Rabida—the monastery where Christopher Columbus lived and watched the building of the small craft which were to take him to the new world. In the chapel of the monastery is the original commission given to him in 1492 by Ferdinand and Isabella, appointing him governor of the sea and viceroy of all the land which he might discover. This building also contains the will of the great navigator.

Now just let us take a few snap-shots of the principal buildings on which I will not comment, as I hope they will speak for themselves. This is a picture of one of the caravels, which crossed over to New York for the opening ceremony of the exhibition. Here is the

Electricity Building on the right, and on the left is the famous fountain by MacMonnies. Here is a nearer view of that famous fountain. This shows you the Administration Building, which was just opposite the peristyle. Within this building were the offices of the various branches of the Administration Department. The Press had their offices in this building, and some editions of the Chicago papers were published here.

Chicago is great in newspapers, which are mostly illustrated in a manner superior to the majority in Europe. The *Chicago Herald* is a specimen. This is published in a building palatial in size. The compositors of this newspaper are certainly lucky mortals. They set up type in a room which is the very perfection of light and ventilation. The lavatory is fitted with marble and is superior certainly to that of many West End clubs that I know. There is a hot and cold shower bath for the men after their day's work is over. Filtered iced water slakes their thirst from silver cups. At the end of the room is a restaurant where they can eat at mess prices. Their pay is 30 dollars a week—£6 sterling. I guess the *Chicago Herald* is a "live paper."

Here is an example of a sanitary precaution. Whenever any dangerous illness breaks out in Chicago the fact is only too palpable to those who keep their eyes open. Placards are placed on the outer door. Returning to my flat one night I found a rather startling announcement affixed to my door on blood-red paper, "Scarlet-fever here." Below was the notice that this card must not be removed except by the Commissioner of Health.

The Chairman proposed a hearty vote of thanks to Mr. Villiers for his interesting and amusing lecture. This was carried unanimously, and the proceedings terminated.

Miscellaneous.

PRIZES FOR CABS.

The Coachmakers' Company are offering prizes of £50 (of which the first prize of £40 is provided by Mr. G. N. Hooper, and the second of £10 by the Company,) for models of a four-wheeled cab. The cab is to be built with a close body and a Victoria body, both having the same under-carriage, the idea

being that either body can be used according to the weather.

The object of the competition is to induce the makers to put on the streets a Victoria such as is used in many continental and other cities.

It may be remembered that in 1872 the Society of Arts offered prizes amounting, in the aggregate to £120 for improvements in cabs—both Hansoms and four-wheelers. The Committee appointed to award the prizes stated what they considered to be the deficiencies which ought to be remedied. These were: want of room; excessive height of the seats in four-wheelers; difficulty in getting in and out of Hansoms; the arrangements for opening and closing Hansom windows; bad ventilation in the Hansom when the windows are closed, and imperfect locking of the wheels in four-wheelers.

The Committee at the time pointed out that Victorias were used in many continental towns, and also threw out a suggestion for a cab capable of being used both open and closed.

In October, 1873, the awards of the Committee were published. After having made careful investigations, they found themselves unable to select any one vehicle for a first prize, and they therefore divided the £120 equally among four competitors; two for four-wheeled cabs and two for Hansoms. The prizes for four-wheelers were given to Mr. Lambert, of Great Queen-street, and to Messrs. Quick and Norminton, of Kilburn. Those for Hansoms to Mr. Thorne, of Norwich, and Messrs. Forder, of Wolverhampton. The cab then introduced by Messrs. Forder has since, with many improvements, been largely introduced into London, and the improvement in Hansoms which has taken place during the past twenty years certainly dates from the offer of prizes by the Society. There appears, however, to have been little improvement in four-wheelers, while the Victoria yet remains to be introduced.

PRODUCTION OF CASTOR OIL IN INDIA.

The United States Consul at Calcutta, in a late report, says that there are three processes by which castor oil is extracted in the Madras Presidency. (1) The seed is roasted in a pot, pounded in a mortar, and placed in four times its volume of water, which is kept boiling. The mixture is then frequently stirred with a wooden spoon. After a time the pot is removed from the fire and the oil skimmed off. The residue is then allowed to cool, and next day is again boiled and skimmed. The oil thus procured is superior to that first obtained, and is kept separate. (2) The seed is first boiled, and then dried in the sun for two or three days. It is then pounded, and the further process is as in the first method. (3) The seed is soaked for a night in water, and next morning ground in the ordinary native oil mill. The oil is removed by putting the pulp into a piece of

cloth, and then squeezing the oil into a pot. This oil is used for lamps and dyeing purposes. In Bengal the castor seeds are partially roasted in a pan, and pounded in a mortar without being husked. The stuff so prepared is mixed with water, and placed in an earthen pot or jar over a fire, the quantity of water used being two or three inches above the level of the crushed seed. As the water evaporates, the oil rises to the surface, and is then poured into another vessel. The jar is then removed from the fire and allowed to cool, after which some cold water is added to the mixture, when the jar is placed in the sun. The oil still remaining in the mixture then appears at the top, and is removed by hand. The oil thus obtained is boiled again in a separate pan, by which process any moisture and all other extraneous matter are eliminated, and the oil becomes purified and fit for consumption in lamps. There is another process for the extraction of oil from castor seeds followed by the people of the Bengal Presidency, which differs but very slightly from that already described. In this method the seeds are boiled with water before being pounded. When they become soft they are placed in the sun, and when dry are crushed. The following processes are adopted by one of the manufacturers in Calcutta in extracting oil from the castor bean. (1) The seeds are first cleaned with the hand by women. They place a quantity of seed on a smooth board and with a flat wooden mallet give them one or two strokes which break the seeds into two or three pieces, thus rendering the separation of the husk easy. The broken seeds are then winnowed with a common basket winnower, which removes the husk from the kernel. The kernels are then dried in the sun and afterwards broken by a crushing machine. They are then put in small canvas or gunny bags, and pressed in a hand machine, the oil falling into a pan placed underneath. The oil is collected in large galvanized iron vats, and bleached by exposure to the sun, which also causes the sediment to precipitate. It is next boiled, in order to evaporate any remaining moisture; vegetable charcoal is added to it, and the oil is then filtered through flannel or blotting paper. The oil thus obtained is of the purest quality, used only in medicine, and is manufactured to order. No fire is applied during the pressure, and therefore no irritating part of the seed finds its way to the oil. The yield, however, is ten per cent. less than that obtained by the following method. In this the seeds are husked, crushed, and pressed as before. At the time of pressing, fire is placed under the machine, the heat from which liquefies the oil and increases the yield, with which, however, a certain portion of the irritating or injurious part of the seeds is mixed. It is then bleached and boiled as before, and filtered with the addition of animal and vegetable charcoal. Some of the jails in India employ many of the prisoners in the manufacture of castor oil. The cleaning and grading of the seeds are done by females, who first remove all extraneous matter such as dust, pebbles, and foreign

seeds, and who then by means of sieves with different sized meshes grade the seed into four sizes. The splitting of the shell is done with a machine which consists of two smooth iron rollers placed parallel to one another and working towards one another. It is worked by hand by a simple arrangement of cogwheels. One of the cylinders or rollers is fixed, the other is movable by a screw adjustment. By means of the latter contrivance, the space between the cylinders can be regulated to the required distance. The space is increased or diminished according to the size of the seed about to be split. A wooden box is placed above the cylinders to hold about eight or ten pounds of seed at a time. These cylinders are about two feet long, so the process of splitting goes on very rapidly. The seed is passed on to the winnowers who separate the husk from the kernel on large masonry platforms. Sunning is a very necessary step in castor oil manufacture, not only to dry any moisture there may be in the kernel, but to liquefy and facilitate the exit of the oily matter. When the kernel is crushed, it is put into canvas bags, which are placed alternately with iron plates into the screw press. As pressure is applied to the canvas bags, the oil oozes out of them into a trough placed below. At the back of the press a fire is kept up to facilitate the exudation of oil. Each canvas bag holds about a pound of crushed kernels, and each feed of the press requires from one hundred and thirty to one hundred and fifty such canvas bags. The thick slimy oil thus obtained is passed into the hands of the boilers, who, mixing it with water in the proportion of forty parts of oil to from five to eight parts of water, boil it in large copper pans. The boiling of the oil is, perhaps, the most delicate process of the manufacture. To know exactly when to stop the boiling is a point of knowledge acquired by great experience. Thermometers were at one time used, but the results were not so satisfactory, and the boiler is now guided by the eye and by his sense of touch. The castor oil plant is largely cultivated in Assam to feed the silkworm. An excellent paper pulp is made with the bark from the stems. The oil is frequently used by the Indian dyers, and it has the reputation of being one of the best for dressing tanned hides and skins. It is also used for lubricating all sorts of machinery, clocks, watches, &c. It is said to be the best lamp oil in use in India, giving an excellent white light, vying in brilliancy with electricity, far superior to petroleum, rape seed, and all other oils, whether vegetable, animal, or mineral. It is used very extensively by the great perfumers in their articles of manufacture, and it enters largely into the making of some kinds of varnish. At the Allahabad East-Indian Railway Station the lamps are lighted with the gas obtained from the castor oil cake, which has been found to be an excellent material for the purpose. This cake is also highly esteemed as a manure; and it is stated that castor oil and bone meal mixed together form a better fertiliser for sugar-cane than either of these

manures alone. In the year 1891-92 the quantity of castor oil exported from India amounted to 3,273,980 gallons, of which the United Kingdom took 1,384,745 gallons.

EUROPEAN COAL PRODUCTION.

THE following particulars are taken from an article in the *Board of Trade Journal*, on the "Coal Production in Western Europe."

In 1865, the four principal countries together, that is to say, the United Kingdom, Germany, France, and Belgium, only extracted 150 million tons of coal and lignite. Germany is the only country which makes a very great use of lignite, which comprises about a quarter of the aggregate coal production, that is to say, 20,536,000 tons in 1891, as compared with 73,715,000 tons of coal properly so-called, and the price of a ton of lignite represents about a third of that of coal.

Although the quantity of coal won in 1865 by the United Kingdom, Germany, France, and Belgium did not exceed 150 millions of tons, in 1875 this quantity had increased to 211 millions and a half, an increase of 60 million tons, or 40 per cent., in 10 years. In 1885 it amounted to 269,800,000 tons, having increased by more than 59 millions in this decennial period, or a proportion of about 28 per cent. Finally, in 1891, the coal production of England, Germany, France, and Belgium together attained the figure of 325 millions of tons, which constitutes in six years only an increase of 55 millions, that is, 9 million tons annually.

In the 26 years comprised within the period 1865—1891, the production rose from 150 million tons to 325 million, that is to say, it increased by more than 116 per cent. The four countries under review each participated to a very considerable extent in the general increase of the coal production, although not all in the same proportion. It is in Germany that the progress has been most marked, then in France, the United Kingdom, and finally in Belgium.

In 1865 Germany only extracted 28,500,000 tons of coal; in 1891 she won 94,250,000 tons, exactly three times as much as in the former year.

To arrive at this total of 94 millions of tons, Germany passed through the following stages:—28½ millions in 1865; 47,800,000 in 1875; 73,676,000 in 1885; and finally 94,250,000 in 1891. The German production at the present time is rather more than half that of England, but it must not be forgotten that in the figures of the German production, lignite is an important factor, this article amounting to nearly a quarter of the total product. In France, while in 1865 only 11,653,000 tons of coal were won, in 1869 the amount had increased to 13,510,000; in 1875 to 16,957,000; and in 1885 to 19,511,000 tons. It will thus be seen that in the 20 years comprised between the periods 1865 to 1885 the French coal production had not doubled in amount. Since 1885, however, considerable progress had been

made, and in 1890, 26,083,000 tons were extracted, about the same proportion being shown for 1891. It follows, therefore, that in the five years, from 1885 to 1890, French coal production increased about $5\frac{1}{2}$ million tons, that is more than a million tons a year. Taking the whole of the period, 1865 to 1891, it will be seen from the above that the production has risen from 11,653,000 tons to a relatively high total of 26,055,000 tons, a very fair amount in itself, but which is far from corresponding to the requirements of French consumption, which needs about 36 million tons.

In 1891 the imports of coal and coke into France exceeded 10 millions of tons, and this amount has shown very little variation since 1883, when it amounted to 10,566,000 tons. The very considerable increase, therefore, of the French coal production, which, since 1865 has amounted to more than 14 millions of tons, or 124 per cent., does not appear to have had the effect of reducing the imports of this raw material, at any rate since 1883.

A marked development has also been observable in the coal production of Belgium since 1865, but in much smaller proportions than in France. Twenty-five years ago this industry was in a very favourable condition in Belgium, but at the present day it is stated that certain of their coal-fields are commencing to show signs of exhaustion. However that may be, the Belgian coal production, which amounted in 1865 to 11,841,000 tons, exceeded in that year, as well as in 1866 and 1867, the French production, but at the present day falls far short of the latter. The amount produced in 1891 was a little over $19\frac{1}{2}$ millions of tons; it is true that in 1890 it exceeded 20 millions, but even this is far behind the French production, which amounted, as has been shown above, to 26 millions of tons. From 1865 to 1891 the Belgian production increased by about eight millions of tons, or a proportion of about 70 per cent., as compared with an increase of $14\frac{1}{2}$ millions of French coal, or 124 per cent. The United Kingdom still holds its place as head of the coal-producing countries, its production, which amounted to 98 millions in 1865, 131 millions in 1875, 159 millions in 1885, rose to 185 millions of tons in 1891, a figure much in excess of the combined coal production in Germany, France, Belgium and Austria. As regards the latter country, considerable progress has also been made, and it is unfortunate that statistics of her coal production are not available for any year previous to 1876, when it amounted to 11,868,000 tons. This figure had risen to 25,376,000 tons in 1891, an increase in 15 years of about 110 per cent.

COCOANUT CULTURE IN CEYLON.

A very large, if not the greater, proportion of the produce is consumed locally in the food and the personal and household requirements of the people.

The exports in 1892 were, in value, as follows:—

	Rupees.
Cocoanut oil, 564,450 cwt., or 7,025,512 gallons, valued at one rupee a gallon, chiefly sent to India, the United Kingdom, United States, and East Europe.	7,025,512
Cocoanuts to United Kingdom, India, Suez, and Port Said, 3,800 bags, Numbering 367,043	433,591
Cocoanuts desiccated	369,778
„ shells to India	29,743
Copperat, 169,073 cwt., to France, United Kingdom, India, and America	1,625,085
Poomac to United Kingdom, East Europe, and India	857,761
Arrach (cocoanut spirit) to India, 88,874 gallons	100,236
Coir, 45,404 cwt., to United Kingdom, Australia, India, and East Europe	340,530
Coir rope, 8,907 cwt., to Strait Settlements, United Kingdom, India, and Australia, and other countries	111,338
Coir yarn, 105,678 cwt., to United Kingdom, India, United States, France, Australia, &c.	634,067
Coir manufactures	6,809
Cadjan	60
Cocoanut rafters and laths	195
Cocoanut husks	45
Total Rupees....	11,524,755

This value is taken from the Customs Accounts, which are probably given below the market prices.

Another estimate made in the island reduces the shipments as to cocoanuts, and is as follows for 1891 and 1892:—

	1891.	Nuts.
Oil shipped	409,521 cwt. = to	163,390,400
Copperat „	45,661 cwt. = to	11,415,000
Cocoanuts „		6,699,403
Desiccated „	1,416,330 lb. = to	4,248,990
Total.....		186,171,793
	1892.	Nuts.
Oil shipped	550,977 cwt. = to	220,390,800
Copperat „	134,590 cwt. = to	33,647,500
Cocoanuts „		9,719,386
Desiccated „	3,849,724 lb. = to	11,549,172
Total.....		275,306,858

The shipments are taken from the Chamber of Commerce figures, and the calculations made as follows:—Oil $6\frac{1}{2}$ candies of copperat to one ton; 1,250 cocoanuts to a candy = to 400 to a cwt. of oil. Copperat 1,250 units to a candy = to 250 nuts to a cwt. of copperat. Desiccated cocoanuts 30 lb. to a 100 units, say 3 nuts to a lb.

If we take the population of Ceylon at 3,000,000, and allow five persons to a family, we get 1,000,000 families. It is safe to say that each family will use

at least one nut per day. This, for one year, will give 219,000,000. To this can be safely added 25,000,000 for drinking purposes. We thus get—

Used in manufactures.....	270,000,000
Used in households	219,000,000
Used for drinking	25,000,000
	<hr/> 519,000,000

or to be within the mark, say 500,000,000 nuts are yielded annually by the bearing cocoanut trees in Ceylon. Allowing 20 nuts per tree, we get 25,000,000 trees; but to those have to be added the trees not yet in bearing, and those set apart for toddy drawing. What their number is it would be rather difficult to ascertain, but for the former 7,000,000 trees, and for the latter 4,000,000 would be within the mark.

This would give a grand total of 36,000,000 tons, which at 70 tons to the acre would give, say, 514,000 acres. These figures are rather under than over the correct number, and over 40,000,000 trees is about the number growing in Ceylon. The best approximate estimate that can be used for the cocoanut palm industry of Ceylon is as follows:—

Area cultivated	550,000,000 acres
Palms, old, full-bearing, young, &c.	42,000,000 trees
Total yield of nuts in a good average year	550,000,000

Half of these are used for manufacturing and export purposes, and the other half for local food and drinking purposes.

On one cocoanut walk of 14 acres in extent, with 1,151 trees, or about 82 trees per acre, the average produce for ten years was 59,020 nuts annually; per acre, 4,215 nuts; per tree per annum about 51 nuts.

PRODUCTION OF PRECIOUS STONES IN SIBERIA.

In a report by the Russian Department of Manufactures upon the Siberia and the great Siberia railway it is stated that the best known place in all Siberia where precious stones are found is the Transbaikalian territory. Here between the rivers Onon and Onon Borza rises the granitic mountain, Adun-Chilon, celebrated for the frequent discovery there of precious stones, such as topaz, beryl, and others. On the Onon, 85 versts from Nerschinsk, are found garnets in small crystals. Lapis lazuli occurs in the Baikal mountains, along the rivers Talaya and Sliudianka flowing into Baikal, and along the stream Bystraya, a tributary of the Iskut. In the last locality, lapis lazuli of good quality form pockets in the limestone near its junction with the syenitic granite. From these deposits was found the lapis lazuli which served for the veneering of the columns in the St. Isaac Cathedral in St. Petersburg, and for the execution of a mass of artistic productions placed in the imperial palaces. In the same locality where the deposits of lapis lazuli occur, dark-red garnets

are met with in crystal attaining two inches in diameter; along the Bolshaya Bistraya, amazon stone, sphene, and feldspar of a crimson colour are found; along the Taloya, mica, serpentine, talc, and other minerals; along the Sliudiunki, blue calcareous spar, white marble, rose-coloured quartz, garnet, asphannite, and others; in the valley of the Uluntui, black mica, in slabs two feet in diameter, is found. Pebbles of nephrite are found along the River Bielaya falling into the Angara, thirty miles below Irkutsk, and along the Iret and Onon, tributaries of the Bielaya. The Attai mountains have become celebrated for their porphyry and jasper of various colours. These are forwarded from the Korgon ridge, from the banks of the Charysh and Alei, and from the vicinity of the Ridder mine to the Kolyvan polishing works, whence manufactured articles are despatched over 2,400 miles to the Imperial Court at St. Petersburg. At these works a mass of remarkable works of art have been turned out, which now embellish many of the imperial palaces. At the present time not less than eight quarries are being worked in the Altai, producing porphyry, blue and green jasper, granite, white and coloured marble, smoky topaz, red, rose coloured and blue quartz, agate and chalcedony.

THE PRODUCTION OF GAMBIA IN SINGAPORE.

Gambier is very extensively employed in the dyeing and tanning industries, and a large number of materials and articles of daily use have, in the course of their manufacture, been treated with this substance. Gambier is, moreover, a valuable medicine, and the more carefully prepared qualities are largely used in cases of diarrhoea, dysentery, relaxed throat, &c. The United States Consul at Singapore says that, similar to ordinary catechu in chemical composition, gambier is obtained by boiling the leaves and twigs of the *Uncaria gambir* plant, a native of the East, and found either wild or cultivated in the Straits Settlements and Johore, as well as in Java and Sumatra. The manufacture of gambier is still conducted on very primitive lines, and with the crudest appliances. A plantation is generally cropped some eighteen months after being planted, and croppings may be repeated as often as four times a year, the operation being conducted with no sparing hand. The remaining process is exceedingly simple. The leaves, twigs, &c., are boiled in a rough cauldron until the water in which they are steeped becomes syrup. The extract is then drawn off, cooled, and stirred until crystallisation commences. The gambier is then cut by hand into cubes, dried, either by simple exposure to the air or by smoke, and packed in mats for exportation. The life of a gambier plantation averages about ten years, and, in fifteen years at latest, it is abandoned. The capital required is very small, and the returns are rapid, hence the

favour with which the industry is regarded by the Chinese. Gambier has a pale brown or yellow colour, with an even earthy fracture, the cubes of commerce being about an inch square. There is much variation in the quality of the gambier offered for sale, and the art of adulteration has penetrated this branch of industry. At one time there are stated to have been 800 plantations in Singapore alone; and the amount of gambier imported into Great Britain alone from the Straits Settlements and Johore is about 20,000 tons annually. Consul Wildman says that improved appliances and management of the Singapore plantations can hardly fail to largely develop the gambier industry at no distant date. While gambier at the present time is used extensively for backing silk, it is rapidly coming into use for tanning purposes. The market price of gambier at Singapore is about 25s per picul (picul = $133\frac{1}{3}$ pounds avoirdupois).

General Notes.

MILAN PHOTOGRAPHIC EXHIBITION.—A notice was given in the *Journal* for November 24th (see *ante*, p. 31), of the combined exhibitions to be held at Milan, from May to October, 1894. Further information has been received from the Foreign Office respecting the International Exhibition of Photography, which forms one of these Exhibitions. It is seven years since the first International Photographic Exhibition was held in Italy (Florence, 1887). The Exhibition will be divided into three classes, viz.:—I. Professional Photography. II. Amateur Photography. III. Technical and Industrial Division. An appeal is made to the photographers of Europe to assist in carrying out the scheme. Charges will be made for space, and applications for the admission of exhibits must be made to the Comitato Speciale per la Esposizione Internazionale di Fotografia in Milano, Via Principe Umberto, N. 30, not later than January 31st, 1894.

MILAN INTERNATIONAL WORKMEN'S EXHIBITION.—This Exhibition is to be carried out in connection with the combined exhibitions mentioned above, and will consist of the following classes:—I. Labour. Including individual labour, small industries, domestic industries, collective work, work of labourers employed in factories or on the land, and a gallery of work. II. Provident institutions, including mutual aid, co-operation, accidents and hygiene, dress, food, and dwellings of the workman. III. Instruction, including asylums and workmen's schools, arts and crafts schools, educational institutions for workmen. Exhibits must be delivered in the Exhibition premises not later than 31st March, 1894. Application should be made to the Italian Chamber of Commerce in London.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

DECEMBER 13.—“Carriage-way Pavements for large Cities.” By LEWIS H. ISAACS. SIR BENJAMIN BAKER, K.C.M.G., F.R.S., will preside.

Papers for meetings after Christmas:—

“London Coal Gas and its Enrichment.” By PROF. VIVIAN LEWES.

“Automatic Balance of Reciprocating Machinery, and the Prevention of Vibration.” By W. WORBY BEAUMONT.

“White Lead Substitutes.” By A. P. LAURIE, M.A.

“Experiments in Aeronautics.” By HIRAM S. MAXIM.

“Automatic Gem and Gold Separator.” By WILLIAM S. LOCKHART.

“The St. Pancras Electric Light Installation.” By HENRY ROBINSON, M.Inst.C.E.

“Electric Signalling without Wires.” By WM. HENRY PREECE, F.R.S.

“Modern Development of Illustrated Journalism.” By HORACE TOWNSEND.

“The Adam Architecture in London.” By PERCY FITZGERALD.

“Pewter.” By J. STARKIE GARDNER.

“Railway Extension in India.” By JOSEPH WALTON.

“The Petroleum Fields of India: their Present Condition and Probable Future.” By R. D. OLDHAM, A.R.S.M., Superintendent Geological Survey of India.

“Indian Currency.” By J. BARR ROBERTSON.

“Telegraphic Communication between England and India: its present Condition and Future Developments.” By E. O. WALKER, M.Inst.C.E., C.I.E.

“Chota Nagpore: its Mineral Wealth and its Industrial Resources, and its value to India.” By J. F. HEWITT.

“The Water Supply and Sanitation of the North-Western Provinces and Oudh.” By SIR AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieutenant-Governor of the North-Western Provinces and Oudh.

“The Forthcoming Antwerp Exhibition.” By EDOUARD SÈVE.

“Morocco.” By Captain ROLLESTON.

“Paraguay.” By A. F. BAILLIE.

INDIAN SECTION.

The meetings of this Section will take place on the following Thursday Afternoons, at Half-past Four o'clock:—

January 18; February 15; March 8; April 5, 26
May 24.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on the following Tuesdays, at Half-past Four or Eight o'clock:—

January 23; February 20; March 6; April 17; May 1, 29.

APPLIED ART SECTION.

The meetings of this Section will take place on the following Tuesday Evenings, at Eight o'clock:—

January 30; February 13, 27; March 13; April 10; May 8.

CANTOR LECTURES.

The following courses of Cantor lectures will be delivered on Monday Evenings, at Eight o'clock:—

HENRY BLACKBURN, "The Art of Book and Newspaper Illustration." Three Lectures.

LECTURE III.—DECEMBER 11.—*The Author*.—His part in the illustration of books—His handwriting—The decorative page—Examples of illustration—Archaic decorative, topical—The Book of the Past—The Book of the Future.

PROFESSOR FRANK CLOWES, D.Sc., "The Detection and Measurement of Inflammable Gas and Vapour in the Air." Four Lectures.
January 22, 29; February 5, 12.

HUGH STANNUS, F.R.I.B.A., "The Decorative Treatment of Traditional Foliage." Four Lectures.
February 19, 26; March 5, 12.

CAPTAIN W. DE W. ABNEY, C.B., F.R.S., "Photometry." Three Lectures.
April 2, 9, 16.

HENRY CHARLES JENKINS, A.M.Inst.C.E., "Typewriting Machines." Two Lectures.
April 30; May 7.

JUVENILE LECTURES.

Two lectures, suitable for a juvenile audience, will be delivered by WALTER GARDINER, M.A., F.R.S., on "Plants: their Foes and Defences," on Wednesday evenings, January 3 and 10, 1894, at 7 p.m.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 11...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Henry Blackburn, "The Art of Book and Newspaper Illustration." (Lecture III.)
Scottish Society of Arts, 117, George-street, Edinburgh, 8 p.m. 1. Mr. Magnus Finlayson, "An Improved Slide-rest for Lanterns." 2. Mr. H. Ramsay Taylor, "Electric Railway Signalling."

3. Mr. H. Ramsay Taylor, "An Improved Form of T-Square with Transparent Edges."

Imperial Institute, South Kensington, 8½ p.m. Mr. J. M. Price, "A New Trade Route across Siberia, by way of the Arctic Ocean, to Peking."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mr. R. D. Oldham, "The Evolution of the Geography of India."

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m.

Mr. Arnold Mitchell, "Old Buildings and the Story they tell."

TUESDAY, DEC. 12... Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Lewis H. Ransome, "Cask-making Machinery."

Photographic, 50, Great Russell-street, W.C., 8 p.m.

1. Mr. S. Herbert Fry, "The Distribution of the Image in Multiple Films." 2. Mr. F. E. Ives, "Observations on the Lumière-Lippmann Colour Photographs."

Anthropological, 3, Hanover-square, W., 8½ p.m.

1. Mr. W. L. Duckworth, "A Critical Study of Australian Crania." 2. Mr. R. Etheridge, jun., "An unusual form of Rush Basket from the Northern Territory of South Australia." 3. Mr.

R. Etheridge, jun., "A modification of the Australian Aboriginal Weapon, termed the Leonile, Langeel, Bendi, or Buccan." 4. Mr. R. Etheridge, jun., "An Australian Aboriginal Musical Instrument."

5. Mr. P. W. Bassett Smith, "The Aborigines of North-West Australia." 6. Mr. H. B. Purcell, "Rites and Customs of Australian Aborigines." 7. Mr. W. G. Aston, "Japanese Onomatopoes and the Origin of Language."

Colonial Inst., Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Capt. W. H. Williams, "Uganda."

Asiatic, 22, Albemarle-street, W., 4 p.m.

WEDNESDAY, DEC. 13...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Lewis H. Isaacs, "Carriage-way Pavements for large Cities."

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

East India Association, 3, Victoria-street, S.W., 3 p.m. Mr. A. K. Connell, "The Financial Condition of India."

THURSDAY, DEC. 14... Royal, Burlington-house, W., 4½ p.m. Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. W. H. Cummings, "Canons and Catches."

Sanitary Institute, Parkes Museum of Hygiene, 74A, Margaret-street, W., 8 p.m. Prof. Watson Smith, "Manufacture of Alkalis and Acids."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m.

Imperial Institute, South Kensington, S.W., 8½ p.m. Sir Julius Vogel, "New Zealand."

Mathematical, 22, Albemarle-street, W., 8 p.m.

FRIDAY, DEC. 15...Civil Engineers, 25, Great George-street, S.W., 7½ p.m. (Students' Meeting.) Mr. H. J. Orford, "Continuous Automatic Railway Brakes."

Queckett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Institute of Brewing, Criterion Restaurant, Piccadilly, W., 8½ p.m. Mr. A. Gordon Salomon, "Raw Grain Conversion in the Brewery."

CORRECTION.—Page 35, col. 1, for Sebastian Evans read Richardson Evans.

Journal of the Society of Arts.

No. 2,143. VOL. XLII.

FRIDAY, DECEMBER 15, 1893.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

ADJOURNMENT OF MEETING.

The discussion on Mr. LEWIS H. ISAACS'S paper, "Carriage-way Pavements for Large Cities," read on Wednesday evening, 13th inst., was adjourned to Wednesday evening next, 20th inst. All those who received invitations to the meeting, on 13th inst., are asked to attend the adjourned meeting. Sir Benjamin Baker, K.C.M.G., F.R.S., will preside at this adjourned meeting, and Mr. G. F. Deacon will open the discussion.

CANTOR LECTURES.

The third and last lecture of the course on "The Art of Book and Newspaper Illustration," was delivered by Mr. HENRY BLACKBURN on Monday evening, 11th inst.

On the motion of the CHAIRMAN (Mr. Cobb), a vote of thanks was passed to the lecturer for his valuable course of lectures.

The publication of the lectures will be commenced in the number of the *Journal* for December 29.

Proceedings of the Society.

FIFTH ORDINARY MEETING.

Wednesday, December 13, 1893; Sir BENJAMIN BAKER, K.C.M.G., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Baker, William King Gaspereau, Cumberland-park, Acton, W.

Banks, Walter, Maisonette, Goldhawk-road, W.
Burchett, Arthur, 28, Willoughby-road, Hampstead, N.W.

Eastes, James Smith, Fairlawn, Ashford, Kent.

Greger, Karl, 17, Gordon-street, Islington, N.

Haig, Axel Herman, Grayshurst, Grayswood-hill, Haslemere, Surrey.

Holiday, Henry, Oak Tree-house, Hampstead, N.W.

Hopkins, Herbert W., 13, Harrington-gardens, S.W.

Howard, Frank, The Chilterns, Wallingford, Berks.

Hunt, Alfred W., 10, Tor-gardens, Campden-hill, W.

Orr, Robert, 8, Great Western-terrace, Glasgow, and West Quarter, Falkirk.

Winter, W. W., Midland-road, Derby.

The following candidates were balloted for and duly elected members of the Society:—

Bishop, Edward, Woodward, Steele's-road, Haverstock-hill, N.W.

Bontor, Frank Arthur, 35, Old Bond-street, W.

Brett, John, A.R.A., Daisyfield, Putney, S.W.

Downer, Frederick, Blake-house, Watford, Herts.

Frampton, George, 32, Queen's-road, St. John's-wood, N.W.

Gardner, W. Biscoombe, Thirlestane, Hindhead, near Haslemere, Surrey.

Mills, William, Bonner's-field, Sunderland.

Over, George Edward, Rugby.

Taylor, Edmund, Tower-buildings, 22, Water-street, Liverpool.

Temperley, Charles, 72, Bishopsgate-street Within, E.C.

The paper read was—

CARRIAGE-WAY PAVEMENTS FOR LARGE CITIES.

By LEWIS H. ISAACS, F.R.I.B.A., Assoc.Inst.C.E.
Surveyor to the Board of Works for the Holborn District.

The art of paving the streets of large cities and towns is of ancient date, and the association of well paved roads with the public health is more intimate than is generally supposed. It is unnecessary to point out that the commerce of a town and the material well-being of its inhabitants are in a large degree dependent upon the excellence or otherwise of the pavement of its thoroughfares. In a word the advance of civilization is as clearly defined by the pavements of our cities as by the architectural fitness and beauty of the buildings which abut upon them.

Our recollections of foreign cities are influenced pleasurably or otherwise by the nature, character, and condition of the roadways and footways therein, and the superior attractions of Paris over New York are as much, if not more, associated with the remembrance of the luxurious ease of vehicular movement in the

former city, as with the too vivid memories of the want of the first necessities of intra-mural communication in the latter.

Of the many thousands who have visited the city of Chicago this year, and who have also seen some of the towns in Northern Italy (Milan, Turin, and Como may be mentioned as examples for our present purpose), it would be instructive to learn, if it were possible, the large proportion that have brought away the liveliest recollections of the *désagréments* in connection with street travelling in the American city as compared with the complete comfort of carriage traffic in the Italian towns.

We must go back to the Carthaginians for the earliest examples of good street pavements, and it was they who instructed the Romans to pave their streets in the same elaborate and solid manner as their highways were paved. At the present day there may be seen in use portions of the ancient pavements of the streets of Rome, and it may also be mentioned that the pavement of Pompeii remains intact even now. In some instances the traffic of 2,000 years has passed over the Roman roads without material or even appreciable injury. Until about the 12th century the mediæval cities were almost all unpaved, then the main streets of the chief towns began to be protected with stone. It was customary for a very long period to have both the carriageways and sidewalks, or footways as they are now termed, paved with the same material, and examples of this method of dealing with the subject are to be met with in many of the old towns in the kingdom. In modern times, and especially in the present day, great care and attention have been bestowed on the footways of our cities, especially on those forming the approaches to the residences of the wealthy and to the attractive places of business in the fashionable quarters.

Let me say the object of this paper is not so much to describe minutely and technically the manner in which the different sorts of carriage-way pavements now in vogue are constructed, as to endeavour to arrive at conclusions in regard to their relative merits and demerits. With this view it will be necessary first to lay down certain general principles which are involved in the formation of suitable carriage-way pavements for large cities—principles as to which all are agreed—and which the advocates of any of the pavements criticized will endorse as being the objects for which these pavements are designed.

Secondly. To enumerate the pavements now in use, and very briefly to describe the materials of which they are composed, and the manner of dealing with the same.

Thirdly. To point out, without bias, the relative advantages and disadvantages of each of these pavements when tested in regard to those general principles with which we started, so that we can arrive at a conclusion which system of paving, after duly balancing the pros and the cons is the best or approximately the best.

For a long time the influence of a good or bad system of carriageway paving upon the health of the inhabitants of our large cities and towns was either ignored entirely, or was regarded as only of secondary importance, but I think I shall be in accord with the prevailing views upon this subject if I give it absolutely first place in the list of the objects to be attained. Again, after safeguarding the public health, I would next place the safety of the animals which have to traverse our roads and streets and draw loads upon their surfaces. This may be held to be giving way to sentiment, but if this branch of our subject be thoroughly threshed out, it may, after all, be found that true economy is not dissociated from a proper amount of sentiment.

So the points to be aimed at in the formation of a good carriage-way pavement may be set out as follows:—

1. It must be a sanitary pavement, and as noiseless as possible.
2. It must be safe for horses, affording sufficient foothold with the minimum of traction.
3. It must be as free from dust and mud as possible.
4. It must be economical, not only as regards its first cost, but also with respect to its maintenance and cleansing.
5. It must be durable.
6. It must be easily cleansed and non-absorbent of moisture.
7. It must admit of being readily taken up and quickly relaid for repairs at all seasons.

Until about a quarter of a century ago these were the only considerations which weighed with the municipal engineer in determining the class of carriageway pavement to be laid in the streets and roads under his charge, but another is now superadded. He has to remember that it is not only the ordinary wheeled traffic for which he has to provide, but also that conveyed on flanged wheels running on iron or steel rails; in a word, the

tramway traffic which is to be met with in all our large towns.

This is neither the time nor the place to descant upon the relative merits and demerits of tramways as a means of intramural communication; but one thing must be admitted by both the friends and the foes of the system, namely, that it has been found impossible up to the present to maintain in good repair for any length of time those portions of a carriageway pavement which are in juxtaposition to tramway rails. It is humiliating in these days of scientific attainment to have to make the admission, but the fact remains nevertheless.

It seems a simple problem to solve, yet in reality it is not so. In the first place, the tramway rails run longitudinally in the direction of the street, whilst the stone setts or wood blocks, as the case may be, are laid transversely; and, secondly, the materials, which are placed in juxta position, are not homogeneous, and consequently do not wear alike. With one description of street pavement, as I shall presently show, namely, asphalt, the introduction of tram rails therein is impossible except at a cost almost prohibitive.

The difficulty attending the repair of a carriage-way pavement in which tram-rails have been laid, is accentuated by the fact that the maintenance of the roadway generally is placed in the hands of two authorities; the tramway company having a statutory obligation to keep in repair the width of the road occupied by their rails, including 18 inches beyond the outer rails, whilst the remainder of the road-way is maintained by the municipal authority.

It invariably follows that when the tramway company want to repair or renew their portion of the roadway, it is found inconvenient on the part of the municipal authority to do the same with the remainder, and *vice versa*. Conjoint action following upon a conjoint study of ways and means is never thought of, and it only too frequently happens that the convenience of the public is utterly forgotten in this conflict of interests.

But to resume. I have endeavoured to lay down the salient points to be remembered in constructing good carriage-way pavements. Let me now state the pavements which are usually met with in the streets of our large cities and towns. These pavements divide themselves into two classes, namely, those which are laid in parallel courses at right angles to the kerbs, and those which are

without joints—longitudinal or transverse. The first class embraces gritstone, granite setts and wood blocks, whilst asphalt, macadam, and ballast or flint roads constitute the second.

Let me, at the outset of my remarks, lay down a general proposition, the importance of which cannot be too much impressed on the mind of the municipal engineer, that whatever the pavement he may have to form, its foundation is of primary consequence, and should receive the same attention as in other engineering work. A carriage-way pavement without a solid foundation is nearly as frail as a house built on sand. A London engineer, of much experience in this class of work, has said that "the foundation is the pavement." The surface material is merely a covering, which of necessity must wear out, and yet the foundation will constitute a pavement. It cannot safely be expected that the pavement will more than temporarily be better than its bed.

The very best foundation for paving purposes is one composed of Portland cement and clean sharp river ballast, when the last named material can be obtained, in the proportion of six of ballast to one of cement. For the foundation of granite-sett pavements, blue lias lime may be used, in the proportion of five of ballast to one of cement. It should be remembered that blue lias lime is not suitable for the foundation of asphalt pavement, as it is apt to "blow." In mixing the concrete, care must be taken to exclude all clay, dirt, or any other material which might be met with in the ballast. If blue lias lime be used, it should be from the hardest and lowest beds of the lias formation. If cement be used, it should be well burned Portland cement, of the best quality and slow setting, of a grey colour when gauged and dry. It should weigh not less than 114 lbs. to the bushel, and not leave a residue of more than 10 per cent., after being sifted through a wire sieve of 2,500 meshes to the square inch.

Next in importance to the foundation is the contour or cross-section of the carriage way. The longitudinal gradient of the road or street in a great degree controls this, it being necessary to give a more convex contour to a level or flat street than to one having a good fall. The material used for the paving has also to be taken into consideration, gritstone requiring more camber than granite, and wood than asphalt. No fixed rule can be given for the cross-section of a carriage-way pavement, but, it may be assumed, that about 1 in 30 to

about 1 in 40 would be sufficient, according to the gradient of the road and the material employed.

Let me now address myself to a brief description of the six different carriage-way pavements comprised in the two classes into which the subject resolves itself, taking these pavements in the order in which I previously placed them.

GRITSTONE SETTS.

Carriage-way pavements composed of gritstone setts are not to be met with in London, and I question if many of the London municipal engineers have even heard of them. In the North country, and especially in Lancashire and Yorkshire, in which there are suitable quarries, they are used to a large extent. The material has many advantages for the paving of carriageways where the traffic is moderate, or where the gradient renders the employment of granite dangerous, whilst wood or asphalt could not even be thought of. It is not, however, sufficiently durable where the traffic is heavy, and this is its great defect, as it involves frequent repairing and renewal, with corresponding expenditure. The stone should be obtained from a good gritstone quarry, and should consist of a hard, light brown or yellowish-brown grit, and not too close a fibre.

The setts must be cut so that the grain of the stone runs parallel to the length of the sett, and consequently at right angles to its width. This is of the utmost importance, as setts with the grain wrongly cut will soon show the effects of wear, and fall into holes. The reason for this is obvious, for where the grain is parallel to the width of the stone, it is in the line of the traffic to which it offers the least resistance. Pavements of this material are not slippery, do not present too much traction, afford excellent foothold for horses, and are speedily laid and repaired. They are not so noisy as granite, and are considerably less expensive, especially when the quarries from which the gritstone is obtained are in the immediate neighbourhood of the work; but for durability and general usefulness they cannot be compared with granite. When the cost of the maintenance, repair, and cleansing has been added to the first cost, the supposed cheapness disappears.

Gritstone setts vary in depth from 8 in. to 10 in., the latter being the most useful and, though costing more in the first instance, are more economical in the end, inasmuch as when the 10-inch setts are worn down, even as

much as two inches, they can be taken up, redressed, and relaid, which the 8-inch sett will not admit of.

The width of these setts varies from 5 in. to 7 in., and the length from 7 in. to 10 in. Although it is to be preferred that gritstone setts should be of one width, it is not absolutely necessary that they should be so, as in the case of granite setts, inasmuch as a horse can obtain foothold on the stone itself, whilst on granite paving the foot of the horse, if placed on the centre of a sett, generally slips back until it reaches the joint. With this pavement, as with granite, the narrower the courses on a sharp gradient the better. The face of the setts may be left somewhat rough, as this will soon be rectified by the traffic. It is not usual to provide artificial foundations for gritstone pavements, unless the ground be found to be soft or unreliable, in which case blue lias lime concrete is used, as previously described. In the north country, where furnace ashes are, as a rule, easily procurable, they are spread on the surface of the foundation to the depth of about one inch, on which the setts are laid.

The grouting used in the north country for this class of pavement, as also for granite setts, differs materially from that which is in vogue in London. The joints, which are usually $\frac{1}{4}$ in. wide, are swept over with gravel or slag until they are about half full, after which they are flushed up with boiling pitch and tar.

I cannot advocate the use of these materials—pitch and tar—for top grouting, inasmuch as, even with the employment of the best component parts, and the greatest care in their admixture, they are apt to give under the influence of the sun, with disastrous results to the pavement and to those pedestrians who may have occasion to walk over it.

This method of grouting, it is only fair to mention, has one feature in its favour, namely, that it prevents water from percolating into the foundation, and thereby destroying it. Before quitting this portion of our subject I ought to say that the somewhat soft nature of gritstone does not qualify it as a suitable material for paving works in conjunction with tramway rails.

GRANITE SETTS.

For durability and economy there is no form of carriage-way pavement now in use that can equal, much less surpass, that made of granite cubes or setts. Great care, however, should be

exercised in the selection of a granite, avoiding the use of one which will wear smooth and acquire a polished surface, for this is practically the only objection to the exceedingly hard granites from the quarries of North Wales and Guernsey, except the noise caused by the passing traffic, which is the great drawback to all granite pavements.

Being non-absorbent they make but little dust or dirt, and are therefore comparatively cleanly. In certain conditions of the atmosphere, in common with most other pavements they are slippery, and they do not afford the ease of traction which follows the employment of wood or asphalt. It may safely be asserted that the noise which the employment of this pavement produces is the main reason why, in these days, granite is no longer regarded as a fit and proper material for the carriage-ways of the leading or more important thoroughfares in our large cities. I need not further dilate upon this branch of the subject, for he would be a bold municipal engineer who would venture to propose for paving the principal streets of a town, over which there passed any considerable amount of traffic, any other than the so-called noiseless materials.

There are a good many granites used for carriage-ways in the United Kingdom, and amongst them the following are most employed: Aberdeen and Guernsey, Blue Penmaenmawr, Clee Hill, Port Nant, Port Madoc, Dalbeattie, and Irish granite. In addition to these, there are the syenites from the Markfield, Groby, and Mount Sorrel quarries in Leicestershire, forming most excellent paving materials, and if erring at all, erring on the score of too great density and hardness, resulting in slipperiness by wear.

Whatever the class of granite that may be determined upon, it is absolutely essential that it be well squared and dressed before it is laid.

The sizes of the setts in most general use are 9 in. by 4 in., or 9 in. by 3 in.; 7 in. by 4 in., or 7 in. by 3 in.; 6 in. by 4 in., or 6 in. by 3 in., and 5 in. by 3 in. The cubes, which are only 6 in. or 5 in. deep, should not be used in leading thoroughfares where the traffic is very heavy; they may, however, be laid in streets of lighter traffic, and whilst, in the case of the deeper setts, the concrete foundation should not be of less depth than 9 in., this may be reduced to 6 in. where the shallower cubes are employed.

Let it also be remembered that a cube 3 in. wide is always to be preferred to a 4 in., as

affording a surer foothold for horses, and, in streets having steep gradients, the 4 in. cube ought never to be used.

Care should be exercised to ensure that the setts are dressed truly square, the sides and ends of each stone being perpendicular to its top and bottom, so that the areas of the two latter are equal. This is absolutely necessary in order to ensure stability and firmness to the pavement, and also to admit of the setts being reversed when, after the traffic has passed along the surface for some years, a relay of the roadway may become necessary. It will be perceived that if the sides of each stone are not truly square to its face, then the bottom is less in area than the top, and a condition of unstable equilibrium is set up in the first instance, whilst the setts cannot be reversed as just suggested. In granite, as in gritstone setts, it is not necessary, as regards the tops of the stones, to have exact uniformity of surface, as a certain amount of roughness is desirable in order to obviate slipperiness.

The contour of a carriageway has been previously referred to, and the necessity for speedily carrying off surface water will at once be recognised. That brings us to the consideration of the channels and the gullies in connection therewith. Ordinarily the channels are formed of two or more courses of cubes placed parallel to the kerbs, and at right angles to the other cubes; but in very flat streets, better channels are made by using blocks of granite 12 in. or 15 in. wide, and of the same depth as that of the cubes. This plan allows the rain or other surface water to flow more quickly to the gullies, there being less friction owing to the less number of joints, and a more even surface. In the case of streets having very steep gradients, a second row of granite blocks similar to those just described, should be laid on the left or "near" side going up hill, and at a distance—centre to centre—equal to the average gauge of the wheels of the traffic most frequently using the street. This class of pavement is of great service to heavy traffic on a steep gradient, affording the minimum of traction to the wheels of vehicles, whilst the granite cubes between give good foothold for horses.

The granite setts having been duly laid, the next operation in connection therewith is the grouting. I have already expressed my disapproval of the mode of grouting with pitch and tar which prevails in the north country. Let me describe the grouting I would use in place of this, and briefly, I would say, where

the concrete foundation is composed of lime and gravel, then the grout should be lime and sand, but where the concrete is mixed with Portland cement, the grout should also be of cement and sand. This ensures the proper amalgamation with the foundation of that portion of the grout which passes through the joints of the setts and falls on top of the concrete. In speaking of these joints, I should observe that they ought to be as thin as possible, the cubes being laid touching stone and stone both on the sides and ends. I have referred to the superiority of the 3-in. over the 4-in. granite cube. Let me, in support of this view, quote what Colonel Haywood—the engineer to the City Sewers, who may be termed the *doyen* of municipal engineers—says on the subject: “The 3-in. granite pavings are the safest, as giving the best foothold for horses; on such a pavement horses were less strained, there was less wear and tear of vehicles, and a greater degree of quietness and comfort; they made the most even pavement, and retained an even surface longer than any other stone pavement that had been tried, and consequently were the best for large towns with great traffic.”

As to the cost and duration of 3 in. by 9 in. setts of Aberdeen granite laid in Gracechurch-street, with a traffic of from 5,000 to 6,000 vehicles per day, he says the cost in the first place was 14s. 6d. per square yard, laid complete. During the time it was down it required three relays, the first five years were free of cost for repairs and the outcome at the end of 25 years was, after giving credit for the old material, as follows:—

	Per sq. yd. for 25 yrs.	Per sq. yd. per year.
	s. d.	d.
First cost, including foundation	14 6	6·96
Repairs, three relays at 1s. each	3 0	2·04
Do. 20 years at $\frac{3}{4}$ d. per year	1 3	
Total expenditure	18 9	9
Credit old material	2 3	1·1
Net total cost	16 6	7·9
		say 7 $\frac{3}{4}$ d.

These figures are useful as demonstrating that the best material of its kind is, after all, the cheapest. In the year 1857 I received instructions to pave the carriageway of High Holborn. I recommended the use of 3 in. by 9 in. Aberdeen granite cubes, but this was overruled on the score of what subsequently proved a false economy, and 4 in. cubes were laid. The paving cost 14s. 9d. per yard, laid complete. It was kept in repair for three

years by the contractors, without cost. It was twice relaid during the time it was down—20 years beyond the three—or, in all, 23 years, at a cost of 2s. 9d. per yard. The figures work out as follows:—

	Per sq. yd. for 23 yrs.	s.	d.
First cost, including foundation	14 9		
Repairs, two relays at 1s. 4 $\frac{1}{2}$ d.	2 9		
Do. 20 years at 1d. per year	1 8		
Total expenditure	19 2		
Credit old material	2 2		
Net total cost	17 0		

or 9d. per square yard per annum (in round figures) for a period of 23 years, at the end of which time the cubes were dressed down averaging five to six inches in depth, and now constitute the paving of several minor streets in the Holborn district. It is, therefore, within my power to state, from personal experience, that granite cubes will last 36 years with a total vertical wear of four inches, and still form a suitable pavement for the second or third class streets of large cities.

It may also be stated in favour of granite, that it forms the most suitable paving material in juxtaposition with tramway rails.

By a letter received from that eminent firm of paviors, Messrs. John Mowlem & Co., I find the prices of granite paving have advanced considerably since these pavements (Gracechurch-street and Holborn) were laid down. Thus the 3 in. by 9 in. laid in the first-named street would now cost 18s. 4d. as against 14s. 6d., and the 4 in. by 9 in. laid in Holborn 16s. 9d. as against 14s. 9d. That would bring the average annual cost of such pavings in the present day, all other charges remaining unaltered, to 9 $\frac{3}{4}$ d. in the case of Gracechurch-street, and 10d. in Holborn, the paving which was the cheaper in first cost proving dearer in the end, owing to the greater waste and loss attending its relaying.

In answer to my inquiry as to the average life of granite paving, Messrs. Mowlem & Co. remark: “We really hardly know what to say beyond giving you two facts, of which we are quite sure, viz.: (1.) 4 in. by 9 in. Aberdeen granite pitching was laid by us in the Commercial-road, Limehouse, in the year 1873, and the bulk of it is there still, and it has only been relaid once with a percentage of new. (2.) The roads round the Central Markets at Smithfield were paved by us with 3 in. by 9 in. Aberdeen granite about twenty years ago. This has, as you know, just been relaid, none

of the stones being less than 6 in. deep, and many of them hardly worn at all. We do not think we should be wrong in saying these roads will last for another ten years, if not more."

On the subject of the charge involved for repairs of granite pavements they state that "the cost of repairs would not average more than say 3d. per yard per annum. This would allow not only for the one relay with a certain percentage of new, but also for other patching repairs."

As to the syenites from the Leicestershire quarries, Messrs. Mowlem & Co. say as follows: "The Edgware-road was laid by us more than thirty years ago with 3 in. by 7 in. Mount Sorrel granite. The stone was taken up when the wood paving was laid about ten years ago, and we sold it to the St. Luke's Vestry to pave streets in their parish; and we should say, without the slightest exaggeration, they will last for another twenty years."

WOOD PAVEMENT.

It must have fallen under the notice of all observant people how much the employment of wood as a paving material has increased of late, but until the receipt of a letter from Mr. Michie, the courteous secretary of the Improved Wood Pavement Company, in answer to one I addressed to him asking for information on the subject of wood pavements generally, I had no idea that the increase was so large. On this branch of the subject Mr. Michie observes, "During the last four years the increase in the area of wood paving is very remarkable. From 1872 to 1889, inclusive, this company laid 1,030,000 square yards, equal to an average of 58,000 square yards per annum. From 1890 to 1893 inclusive, 520,000 square yards, equal to an average of 130,000 square yards per annum. This year we are paving for the Strand district 22,000 square yards; for the Hackney district, 28,000 square yards; for the St. George's district, 26,000 square yards; various districts, 20,000 square yards; all at present macadam or stone pitching, and in one case asphalt. In Kensington and the City we are doing about 40,000 square yards, but in this case there is no increase of area, as the roads were already wood paved. We are extending our operations to the outlying districts, such as Chiswick, Kilburn, and Hampstead. Several of the vestries are doing their own wood paving. I am, therefore, not in a position to state correctly the extent of their work, but, on the whole, they are increasing the area of

wood paving enormously." From the same excellent authority I learn that the current price of wood pavement, laid according to the system of the Improved Wood Pavement Company, is as follows:—Six inches of Portland cement concrete, floated to a fine surface, 5 in. block of yellow deal, pickled in creosote oil; $\frac{1}{4}$ in. joints run in with asphalt (about one inch) and cement grout, top dressing, &c., about 8s. per square yard. If creosoted under pressure, 8s. 6d. per square yard. In regard to maintenance, the company are prepared to keep in repair the carriageways laid under their system one, two, or three years free of cost, according to agreement, and for a further 15 years at from 7d. to 1s. per square yard per annum according to the traffic. As to the life of the Improved Wood Company's pavement, Mr. Michie estimates it as from 7 to 10 years, the average being as nearly as possible 9 years. Assuming, therefore, that for a first-class thoroughfare the wood pavement cost, in the first instance, 8s. 6d. per yard, that for two years it was maintained free of cost, and for a further 15 years it was maintained at 1s. per yard per annum, 15s., or a total of 23s. 6d.; this, divided by 17, would represent the nett annual cost per square yard to be a fraction over 1s. $4\frac{1}{2}$ d.

This compares with $9\frac{3}{4}$ d., average annual cost of the granite paving in Gracechurch-street over a period of 25 years, or 10d. per square yard of the Holborn pavement over a period of 23 years. It should also be borne in mind that, in the case of the granite pavements, the material when taken up after these long periods of service still admitted of further use in minor streets. When we come to consider the cost of asphalt pavements, the same economy as to granite for a paving material will, no doubt, receive further demonstration.

It will be said that I have addressed myself to the question of the annual cost of wood paving before giving a description of the manner of laying it, which savours rather of "putting the cart before the horse;" but as I had just worked out the figures of cost in regard to granite setts, I was tempted to compare them with those relating to wood blocks. Let me at once proceed, however, with the necessary description of laying these blocks.

It is unnecessary to mention again the concrete foundation, as my previous remarks in regard to concrete for granite setts equally apply to wood blocks. Taken all round, the best wood to use for this purpose is Baltic

red timber or yellow deal, which must be thoroughly sound and well seasoned, absolutely free from sap, shakes, knots, or other imperfections.

Within the last few years there has been a strenuous endeavour to introduce denser and harder woods for paving purposes, notably Jarrah and Karri wood, but objection is taken to these woods that they are hard and slippery, and also noisy. I have before me an account of the meeting of the Kensington Vestry on the 8th November last, in which a report was submitted from the Works Committee stating that complaints had been received relative to the noise caused by the trial sections of Jarrah and Karri wood recently laid in the Brompton-road, and the Works Committee recommended that the sections of hard wood in question be removed, and creosoted deal blocks substituted therefor, and, after some discussion, the recommendation was agreed to. The expense of these woods, also, is almost prohibitive, the comparison being £10 10s. for yellow deal, as against £23 10s. for Jarrah, so that Jarrah would require to last 17 to 18 years to be equal in price to yellow deal creosoted.

The setting the wood blocks should not commence, as in the case of granite pavement, close to the channel, but about seven or eight inches away from it, this space being the last to be filled up, so as to allow for any swelling of the wood, and thus counteract the pressure against the kerbs, and lessen the likelihood of their being forced out of place. In the early days of wood paving, and, indeed, until a comparatively recent date, joints of about $\frac{1}{4}$ in. to $\frac{3}{8}$ ths of an inch wide were made between the parallel courses of the wood blocks, and these were obtained either by using laths of the required width, placed between each row, and afterwards removed for the grouting, or by means of three iron studs having square heads, and driven home into the side of the block, so as to form an equilateral triangle, the latter being the preferable mode. Of late, the joints between the courses have been done away with, and the blocks are laid close together, as in paving with granite cubes, the sides and ends touching. It has been found that this close-jointed pavement results in a longer life, the reason not being difficult to find, the abrasion and rounding of the wood blocks being more pronounced when laid with a joint between each course than when laid with the sides touching. The grouting may consist of Portland cement and sand only, or of pitch and tar or asphalte

for two-thirds of the depth of the blocks, with Portland cement grouting on top of that. The Improved Wood Pavement Company simply brush or squeegee hot tar, tempered with a little pitch, over the surface, until it disappears between the blocks, and then spread a little sand over all. The channels should be formed by means of two rows of blocks, laid parallel with, and not transversely to, the direction of the street, four inches below the kerb, and flush with the other blocks.

Wood blocks are not a suitable material for paving next tramway rails, as they are unequal to the wear and tear of the tram itself, to say nothing of the goring which takes place on the edges of the tram rails, by reason of the ordinary vehicular traffic. I could cite many instances as to this, but a case, which no doubt has come under the observation of many here, is that part of the Gray's Inn-road lying in the parish of St. Pancras, paved with wood some three or four years ago, and which has been in the hands of the road authority ever since, owing to the deep and dangerous ruts formed next the edges of the tram rails by the traffic of the tram itself, as well as that of the ordinary wheeled traffic. Many palliatives for this have been tried, such as the insertion of Jarrah or Karri blocks next the rails, but the resulting improvement is not very great, whilst the inconvenience to the public is at times almost intolerable.

With regard to gradients, no road should be paved with wood having a greater fall than 1 in 30, or at most 1 in 27, and constant and watchful care should be exercised during certain conditions of the atmosphere, when it may be necessary to use grit to prevent slipperiness.

The advantages of wood pavement are :—

1. It is, as yet, absolutely the least noisy of all pavements.
2. It gives the minimum of traction with the exception of asphalte.
3. It is comparatively clean, as, if properly formed, it should make little or no dirt.
4. In the event of a horse falling on it, he can rise more easily than on a granite or asphalte pavement.

But wood pavement has one most serious disadvantage. It offends more than any other against public hygiene. If time would permit, I could quote the opinions given by authorities both at home and abroad in proof of this assertion. But I will content myself by asking you to rely on the evidence afforded by your own sense of smell as to this. Let any

one dwell, say for twenty-four hours, by the seaside or in the pure air of a rural district, and travel to town, alighting, for example, at the Victoria Station, the roadways of which, as you know, are paved with wood. What greets him on arrival? The most sickening odour given off by the pavement in question. You will say this is mainly or entirely owing to the circumstance that the wood pavement is under a glass roof on which the rays of the sun at times fall fiercely. But step across the station yard and traverse Victoria-street. The same sickening odour—if not quite so overpowering as in the station itself—follows you. And this leads me to say, avoid using wood pavements in narrow streets, or even in comparatively wide streets where the height of the buildings which abut on the same prevents the free passage of air. I shall have to deal further with this portion of the subject when I come to speak of street cleansing.

ASPHALTE PAVEMENT.

We now come to the consideration of the second group of carriage-way pavements, namely, those which are made without joints, either longitudinal or transverse, and foremost amongst these is asphalt. Asphalt is a bituminous limestone or pure carbonate of lime impregnated with bitumen. It is found as a rock, and contains about 90 per cent. of carbonate of lime and 10 per cent. of bitumen. The asphaltes chiefly used in road paving in Europe are brought from Val de Travers, near to Neuchatel in Switzerland, from the Pymont and Garde Bois mines at Seyssel in France, and from Limmer in Hanover.

In the United States of America, a mixture of refined asphalt (obtained from the famous asphalt lake in the Island of Trinidad) with sand, limestone, and petroleum oil, in certain proportions, is used for the carriage-ways of many of the leading cities of the Republic. I have received a pamphlet from the Barber Asphalt Paving Company, of New York and Washington, in which it is stated that whilst the total area of asphalted road-ways in Europe is only 2,033,200 square yards; in the United States the Trinidad asphalt has been employed in covering of 6,431,790 square yards, equivalent to 421 $\frac{2}{3}$ miles of road-way 26 feet wide.

I regret being unable to furnish any figures as to cost, but I am in hopes that in the discussion which will follow the reading of this paper, some information on this head may be afforded us.

Great care should be exercised that the bitumen is in its right proportion, since if it exceeds 12 per cent. the asphalt becomes soft and wavy under the influence of the sun, and where only 8 per cent. is present the asphalt is somewhat brittle and therefore liable to crack.

I have previously pointed out that the concrete foundation on which the asphalt is laid should be composed of Portland cement, and not of hydraulic lime; and in proof of this let me mention what befell me in my first trial of this material for paving purposes. I was instructed in the year 1870 to lay down an area of 2,000 superficial yards of asphalt in High Holborn by way of testing its suitability. For this purpose I removed the wood paving then forming the road surface, which was about 5 in. deep, and rested on a bed of concrete composed of blue lias lime and Thames ballast, 9 in. deep, and in excellent condition. To make up the difference in depth between the wood blocks and the asphalt I placed a further layer of the lias lime concrete on top of the old bed, and had the mortification of seeing my economical intentions frustrated, inasmuch as the concrete "blew," and the asphalt followed suit. In the end both the asphalt and the concrete had to be removed and Portland cement substituted for the blue lias lime.

In the preparation of compressed asphalt the rock is first thrown into a crushing machine, which reduces it to about the size of walnuts. It must then be pulverised in a proper disintegrator, from which it falls ready for heating. In the last-named process care must be taken to prevent the powder calcining on the one hand, and on the other, that sufficient heat is obtained to cause the material to adhere by compression. The temperature varies according to the nature of the material, but is generally 250° to 270° Fahrenheit.

In laying asphalt roadways the powder is spread over the foundation to a depth of 3 in., which will after ramming be reduced to a little over 2 in. When the material has cooled to the temperature of the atmosphere the traffic may be allowed to pass over the road. I ought to mention that 1 in 60 is about the steepest gradient permissible with this material.

Temperature does not appear to have any appreciable effect upon asphalt pavements. In Paris, where the sun's rays are generally more powerful than in London, the pavement remains firm, and has no tendency to become

pliant. Its power of resisting compression has also been severely tested, for it is on record that, during the erection of the additional Post-office in St. Martin's-le-Grand, a block of granite, weighing $17\frac{1}{2}$ tons, carried on a trolley weighing 3 tons, or, in all, $20\frac{1}{2}$ tons, equal to $5\frac{1}{8}$ tons per wheel, passed over some asphalté pavement without making the slightest impression thereon.

On the score of durability, asphalté takes a high stand, in proof of which it has been stated that after it had been laid down in Cheapside eight years, with a traffic of more than half a million tons per annum per yard of width, it had only been reduced in bulk $\frac{6}{15}$ ths and $\frac{3}{8}$ ths in weight, and if this wear was proportional throughout, it was calculated the life of the pavement in question would not be less than 22 years. Much would depend, however, upon the part of the roadway from which the trial piece was taken, whether from the crown of the road or near the kerbs, and, again, whether new asphalté had been laid for the repair of that particular spot.

As to the cost of laying asphalté, in the first instance, and its subsequent maintenance, I addressed letters of inquiry to Mr. Bassett, the Manager of the Val de Travers Asphalté Paving Company, and to Mr. Vian, the Secretary of the French Asphalté Company, and the answers received from those gentlemen practically amounted to this: that for an asphalté pavement, suitable for a leading London thoroughfare, $2\frac{1}{4}$ in. thick, on a bed of Portland cement concrete 6 in. thick, the price is 14s. 6d. per yard superficial, the contractor keeping it in repair two years free of cost. The subsequent charge for maintenance varied according to the nature and quantity of the traffic passed over the carriageway; thus, whilst Coleman-street cost only 3d. per yard per annum, Cornhill cost 1s. 6d. and Cheapside 1s. 9d. Taking the two extremes, the mean is 1s. per yard, which is the price paid for maintaining the asphalté carriageway of High Holborn, for a period of 15 years, after being kept at the contractor's cost two years. It would, therefore, follow that the first cost at 14s. 6d., and maintenance for 15 years at 1s., would amount to 29s. 6d., and this, divided by 17, would give, in round figures, 1s. 9d. as the cost per yard superficial per annum during the life of the pavement. This figure of 1s. 9d., therefore, compares with our two examples of granite pitching, $9\frac{1}{4}$ d. in Gracechurch-street, and 10d. in Holborn; as, also, with 1s. $4\frac{1}{2}$ d. for wood paving.

The asphalté companies say it is often found that, after 17 years, the material is still in good condition, in which case they continue to maintain it at a slightly higher cost per yard. Thus, the French Asphalté Company paved King-street, Cheapside, in 1874, the contract for the maintenance of which expired in 1891, and was then renewed up to 1896.

In the City of Berlin, the asphalté contractor has to maintain his pavement gratis for four years, and then receives an agreed sum per yard superficial per annum for 15 years. Mr. Vian, in his letter to me, writes as follows:—"It is usually found that, in main thoroughfares in the City of London, the 17 years allotted is a fair life, and that after that time the pavement is better for being relaid. On the other hand asphalté has not been long enough in use as a paving material for any statement to be made as to the possible length of its life under more favourable conditions. Pavements are in existence which were laid twenty years ago, and have, so far, not yet required repairing, and which may, for anything that is known to the contrary, easily endure for another twenty or even forty years. Such results are attained in side and back streets where there is sufficient traffic to keep the asphalté firm, but not enough to wear it away to any appreciable extent. It would therefore be an under estimate of the truth to say that the average life of an asphalté pavement is twenty years."

I give you this extract from Mr. Vian's letter, but it must not be understood that I endorse all he advances, for I am a little sceptical about a forty years life of an asphalté pavement anywhere, even under the most favourable circumstances. I give you another extract from Mr. Vian's letter which is also very interesting. On the question so often raised of the slipperiness of asphalté he says: "Recent statistics taken in Berlin show that accidents to horses caused by their slipping on asphalté become fewer and fewer, although the area of the asphalté-paved surface is continually being increased. The reason, is partly, that the horses become accustomed to asphalté, and partly that, as asphalté-paved streets become more numerous, less mud is brought on to the asphalté from streets otherwise paved, and it is dirt of this sort which is the chief cause of slipperiness. Unless a great revulsion in public feeling takes place in Berlin it may be safely anticipated that before many years have passed the whole

city will be paved with asphalte. Eighty to a hundred thousand square yards are systematically so paved each year, and active competition prevails among the inhabitants of streets not yet thus favoured as to which has the better claim to have an asphalte pavement first."

These observations on the very extended use of asphalte as a paving material in Berlin are quite confirmed by a letter from Mr. Louth, the agent of the Neuchatel Asphalte Company in that city, whose acquaintance I had the pleasure to make when visiting Berlin some few years ago. Mr. Louth says:—"Berlin is a city of 1,600,000 inhabitants, not reckoning the suburbs, and has a total street area (carriage ways) of 4,900,000 square metres. Of this, 1,020,000 square metres is paved with compressed asphalte, of which we have laid 415,000. Wood paving has been laid to the extent of 82,000 square metres. Asphalte has been extensively laid of late; this year about 80,000 square metres." On the subject of slipperiness, caused by dirt, Mr. Louth remarks:—"The main streets (asphalte) are thoroughly washed and cleansed every morning by gangs of cleaners. During the day the men and boys work singly, but should a good shower of rain fall, they immediately assemble, and make use of the opportunity to wash and clean the streets again. Owing to the general dryness of the climate, the asphalte is less slippery here than in London. Fogs are quite unknown. Snow, of course, is very troublesome on the asphalte. Asphalte is certainly the favourite paving; and 100 petitions to the town council from the inhabitants of 100 streets, asking for asphalte, is nothing unusual in the course of a year. This speaks for itself, and needs no comment."

Accompanying Mr. Bassett's letter is a sample of the original asphalte paving of Threadneedle-street, laid in May, 1869; and cut up when the street was relaid in August last, a period of over 24 years. Threadneedle-street is not a street of large traffic, but this sample may be accepted as the best possible evidence that the life of asphalte pavements in back or side streets is not limited to 15 or 20 years.

On the score of hygiene, asphalte holds pre-eminently the first place, owing to its impermeability and the consequent impossibility of absorption on its part, and in addition to this it may be stated in its favour that it is more easily cleansed, and dries more readily than any other pavement. It is free from jolting, is

comparatively noiseless, and is readily repaired in a very short time.

Another most important advantage results from the employment of asphalte for carriage-way paving, namely, that it is not necessary to close the street when used for the purpose of being repaired. Mr. Bassett, in proof of this, says in his letter to me, "the first sample of asphalte carriage-way paving was laid by us in Threadneedle-street in May, 1869; this was relaid by us when repaving the rest of the street in August, 1893, and during the whole of this period of twenty-four years the street remained open to traffic. Cheapside and Poultry were laid by us in 1870, and kept open to traffic without intermission for eighteen years, when the asphalte surface was relaid. The carriage-way of Old Broad-street was laid in 1871 by us, and maintained open to traffic for seventeen years, when we relaid the asphalte surface."

I will treat of the alleged slipperiness of asphalte and its possible cure, when I take up that portion of my subject which deals with street cleansing.

MACADAMIZED ROADS.

I will now rapidly deal with this and the one other carriage-way pavement embraced in the second group, and I may admit that it was my intention originally to disregard macadamized, flint, or ballast roads, as these come more strictly within the science or art of roadmaking, but looking to the fact that in the suburbs of our cities these forms of pavement are largely in vogue, some notice, however brief, must be taken of them.

The foundation for macadamized roads in and about London is formed of "Hardcore," that being the term applied to a mixture of the *débris* of builders' and dust contractors' yards, clinkers from gas and other furnaces, broken pottery, and other hard material. In the north of England and towns situate near blast furnaces the foundation is of slag. The thickness of the foundation depends upon the nature of the subsoil, the amount of traffic to pass over it, and the materials with which it is to be formed, but it should not be less than 12 inches in thickness. This should then be rolled until 8 in. or 9 in. thick; on this a layer of Thames ballast five inches thick should be laid, and the whole well rammed down. The macadam, or broken granite, is then laid on the ballast in three successive layers three inches thick, rolled separately, until the three combined form a substance of six inches;

upon this a thin layer of sharp sand should be scattered, well watered and rolled.

Broken Guernsey granite, the size of which should not be more than $2\frac{1}{2}$ inches, forms the best metalling. The roller employed should not weigh more than five tons, for when rollers of heavier weight are employed they are apt to crush the gas and water services, and even to cause injury to the mains themselves.

An ordinary macadamised road constructed in this manner costs about 6s. per square yard in London, and when the traffic is heavy, repairs become very costly, for upon the road is put material costing 13s. per cubic yard, to be pulverised and carted away either in the shape of mud or dust at an additional cost of 4s., or a total of 17s. for material only. It is on record that when Piccadilly was a macadam road, the annual cost of maintaining it was 4s. per square yard per annum. This fact tends to prove that the limits within which macadam roads are suitable for heavy traffic are soon reached.

Macadamised roads will not admit of tramway rails being laid therein, as there is not sufficient bedding or packing for the sleepers and rails. Granite pitching has therefore to be resorted to with the resultant noise and the additional drawback that, if the pitching does not extend for the whole width of the road, it becomes a most difficult matter to keep the breasts of the road in proper repair. Macadam for the main or busy thoroughfares of cities or large towns should not be used, owing, firstly, to the excessive cost of maintenance, averaging 2s. 9d. per square yard per annum; secondly, the frequent interruptions to traffic whilst undergoing repairs; and, thirdly, to its unhealthiness, caused by the dust produced in dry weather, which, with the organic matter given off therewith, is carried by the wind to be inhaled by those living in, or passing through, thoroughfares so paved.

FLINT OR BALLAST ROADS.

The objections urged against macadam apply with equal, if not greater, force against these roads, inasmuch as the materials used for the metalling are still more easily pulverised, and, therefore, more readily converted into dust or mud. The one saving clause is that, as flint or ballast roads are only met with in second-class thoroughfares where the traffic is ordinarily very light, the grinding process is not so heavy and continuous as in the main and busy streets of a town. I have been

unable to obtain any reliable statistics of first cost, or of maintenance, for, as a general rule, these second-class roadways are but indifferently made and maintained, but probably we shall not be much out if we put the average annual cost at something like 1s. 6d. per square yard.

STREET CLEANSING.

Cleanliness of surface has a very important bearing upon the slipperiness or otherwise of all carriage-way pavements; some, however, are affected to a greater degree thereby than others. Wood and asphalté must be kept clean for safety. These pavements are most slippery when they are in what I term the transition state, that is to say, when slightly wet or imperfectly dry. When very wet or very dry, they are as safe as, if not safer than, any of the others. Colonel Haywood has shown that when the pavement is damp, a horse can travel 125 miles before it falls; when the pavement is wet, 193 miles before it falls; when the pavement is dry 223 miles before it falls.

The art of cleansing the surfaces of our roads is but imperfectly understood in this country. The fault does not entirely lie with our municipal engineers, nevertheless, we must cross the English Channel in order to see what systematised and efficient street cleansing can do in order to make street surfaces not only innocuous, but agreeable to both sight and smell. Paris, Berlin, Vienna, even Budapesth, although the last-named is almost on the confines of civilisation, can give us most useful lessons in this particular.

I referred just now to a letter I had received from Mr. Louth, the manager of the Neuchatel Asphalté Company at Berlin, and I read the following paragraph therein:—"The main streets (asphalté) are thoroughly washed every morning by gangs of cleaners. During the day the men and boys work singly, but should a good shower of rain fall they immediately assemble and make use of the opportunity to wash and clean the street again." That is what I term systematic and efficient street cleansing. I cannot shut my eyes to one thing that is involved, namely, a copious supply of water that can be used, so to speak, utterly regardless of cost. This supply should be for purely municipal purposes, such as the extinguishing of fires, the washing of streets, and other paved surfaces, and the flushing of the public sewers. It follows therefore that it need not be filtered nor dealt with by the expensive processes necessary for the water

used for domestic purposes. No such supply exists in London, however much better off provincial towns may be in that respect. On the contrary, in London the water is retailed to the municipal authorities at prices which are almost prohibitive, and the operations connected with efficient street cleansing are severely handicapped thereby. Let me dwell upon this branch of my subject just a little longer. The supply of water I am pleading for is for municipal purposes only. It should be supplied at the cost of all London, and should be at the service of all Londoners, without further expense than the repayment of principal and interest on first charge and cost of necessary maintenance, and that duly authorised municipal bodies should be at liberty to take it for municipal purposes where, when, and as often as, they pleased. This would render feasible what I have always maintained is the only rational manner of dealing with the paved surfaces of a town, to treat them as you do the paved surfaces of your houses when you desire to cleanse, namely, to wash them. You could render the hygienic effect of this treatment more pronounced if such simple disinfectants as certain of the residuals of gas manufacture were added to the water when atmospheric conditions rendered that course necessary.

I am informed that a gallon of soluble creosote, or a gallon of liquid carbolic acid, added to 2,000 gallons of water, would prove in each case an invaluable disinfectant at but trifling cost. As regards wood pavements and the offensive miasmatic odours now given off therefrom, previously referred to in this paper, the effect of the suggested washing and antiseptic treatment would go a long way to remove the distrust in which this form of pavement is now held, and speedily restore it to public favour.

COMPARATIVE MERITS AND DEMERITS.

At the commencement of this paper I stated what were the salient points to be aimed at in the formation of a good carriage-way pavement. Let us see how the different materials we have been considering come out of the inquiry. I discard from this award of relative merit and demerit all other materials, save granite, wood, and asphalte, gritstone being only locally employed, whilst macadam and ballast would only be used in the suburbs of large cities and towns.

On the score of public hygiene.—Asphalte

is absolutely first, granite second, and wood third.

Noiselessness.—Wood first, asphalte second, and granite third.

Safety for horses.—N.B. This is under existing conditions as to cleansing. Wood first, asphalte second, granite third.

Cleansing.—Asphalte first, granite second, and wood third.

Durability.—Granite first, asphalte second, and wood third.

Economy.—Granite first, wood second, and asphalte third.

Facility of repair.—Asphalte first, wood second, granite third.

Facility for tramway rails.—Granite first, wood second, asphalte third.

For convenience of reference I have tabulated these results and they come out as follows:—

Asphalte figures in the first column three times, wood twice, and granite three times. In the second column asphalte three times, wood three times, and granite twice; and in the third column asphalte twice, and wood and granite three times each.

TABLE OF COMPARATIVE MERITS AND DEMERITS.

	First.	Second.	Third.
Public Hygiene.....	Asphalte	Granite	Wood
Noiselessness	Wood	Asphalte	Granite
*Safety for Horses ..	Wood	Asphalte	Granite
Cleansing	Asphalte	Granite	Wood
Durability	Granite	Asphalte	Wood
Economy	Granite	Wood	Asphalte
Facility of Repairs ..	Asphalte	Wood	Granite
Facility for Tramways.	Granite	Wood	Asphalte

* This is under existing conditions as to cleansing.

In determining, however, which of these three pavements stands first, it must previously be settled what is the importance of the salient points relatively to each other, and therein lies the difficulty. From the hygienist's point of view, asphalte would be pronounced the ideal pavement, the pavement of the future, in fact; from the economist's point of view, granite would occupy that proud position; whilst with the brain worker, the invalid, or the man of business, wood would occupy first place. There can be no doubt of this, how-

ever, that, as before stated, asphalté and wood are the only materials thought of now a days for the carriage-ways of leading thoroughfares.

It does, not, therefore, follow that these materials occupy antagonistic positions to each other; there is plenty of room for both. Wood is suited for the paving of wide places exposed to the air, such as the roads which abut on Hyde-park and Kensington-gardens, both on the north and south; or if the present extravagantly costly mode of metalling the Victoria-embankment were done away with, wood might well be substituted. Asphalté, on the other hand, forms a perfect pavement for streets like Cheapside, Cornhill, Lombard-street, and the hundreds of other narrow streets and places to be found in London and other great cities. And not only does asphalté come in as the proper material for paving narrow streets, but also where comparatively wide thoroughfares have been deprived of their fair share of light and air by reason of the excessive height of the buildings which abut thereon. Be that as it may, it now appears certain that the roadway of the future will necessarily be an elastic and noiseless roadway, and at the same time durable. When sufficient trials shall have demonstrated the best elastic roadways, asphalté, wood or others yet unknown, granite setts will be found in company with macadam in the suburbs of our cities and on our country roads.

In conclusion I have to tender my grateful thanks to those whom I have had to trouble with enquiries on the many points raised in this paper and for the assistance they have rendered. To Colonel Haywood whose reports have afforded me much valuable information, to Messrs. John Mowlem and Co., the eminent paviors, to Mr. Michie, the Secretary of the Improved Wood Pavement Company, to Mr. Vian of the French Asphalté Company, to Mr. Bassett, the General Manager of the Val de Travers Asphalté Company, to Mr. Louth the Agent of the Neuchatel Asphalté Company in Berlin. To the last named I am indebted for the section showing the mode of laying tramways in conjunction with asphalté paving, and for the interesting statistics in regard to the rapid increase of asphalté pavement in that city. Lastly, to the authors of the three essays on carriage-way pavements which, in the year 1890, received premiums from the Paviors Company—an ancient city guild which demonstrated its belief in the value of technical education by offering premiums for essays on this

subject, that being the first work to which the company devoted itself on its resuscitation.

DISCUSSION.

THE CHAIRMAN said the inhabitants not only of London, but of every great city in the world, were keenly interested in the subject of the paper which had been so ably placed before them that evening. Although every fact had been stated in the most judicial manner, still it was bristling with points for discussion, as there were so many points of uncertainty in estimating the relative value of the different kinds of pavement. Mr. Walter Besant, in his interesting book on London, told them that the old paving of London was cobble stones, and it was not till 1762 that Westminster led off with Scotch granite setts, the City of London, four years later, following this example. He had been struck on several occasions as to the great difference of opinion which existed with regard to wood paving. About twelve months ago he accidentally came across a pamphlet from which he learnt that fifty years ago things were so bad in London that a number of gentlemen formed themselves into a society for the scientific and practical improvement of street paving. They said that in Holborn wood had been laid down for four years, and the reference in the report to the subject, which was rather interesting, was as follows: "Upwards of four years have now elapsed since the adoption of wood paving, and several contractors will undertake to keep their respective pavements annually in repair at the rate of 3d. to 6d. per yard in that line of traffic, where by the continued use of macadam road the different parishes were subject to an outlay of 2s. per yard. Those proprietors who hired vehicles from coach-makers, and drove into the city by the line of Oxford-street and Holborn, have been able to reduce the sum paid per mile in consequence of the extensive use of wood-paving, and it is believed that the fare by omnibuses can be considerably reduced, from 6d. to 3d. It is greatly to be regretted that, by an oversight of Her Majesty's Ministers, they, whilst reducing the burden on foreign timber for certain purposes, have laid heavy duties on blocks employed for wood paving." Whether this was the reason why wood paving was abandoned soon after 1842 he did not know, but the report showed they were alive to what had been recommended by Mr. Isaacs, viz., the importance of having a solid foundation. When in Detroit, six years ago, he found they were doing exactly the converse of what was being done in London—they were changing to stone. In the report of the Board of Public Works it was stated: "We have now 75 miles of wood paving, much of which has been in use for years, and all of which must, in the usual course of things, be replaced in the near future, and we will still be as far from a

durable and permanent roadway as ever. The Board would recommend stone, laid in the best manner, in busy streets, as being the most durable and satisfactory in all respects of which they have knowledge. The only way will be by discontinuing the practice of laying new pavement with wood, and substituting stone in worn-out parts." He found the same opinion expressed at Chicago. There the Board of Public Works said: "The tendency is towards the use of a more permanent material. This should be encouraged, so that in a few years all the great thoroughfares of the city will be paved with granite, or some other substance more durable than the old-time wood block." That was a very good illustration of what Mr. Isaacs had directed attention to, that after all, whether wood, granite, or asphalt was to be used would depend upon the number of marks of efficiency placed against them in the table. In Canada, and especially in Toronto, the paving chiefly consisted of round cedar blocks, but it was found perfectly intolerable adjoining the tram-lines, and the authorities had been absolutely at a loss to know how to solve the problem. In London they had also failed to solve this problem. As a matter of experience, it had been found that in ordinary business streets the wear of the wood blocks was one-fifth of an inch per annum, and, in a busy thoroughfare like Holborn, Mr. Isaacs calculated the wear of granite at one-ninth.

Mr. H. H. BRIDGMAN (Chairman of the Com-

missioners of City Sewers) said that with the growing traffic of the great metropolis they were obliged to have a more enduring paving than macadam, especially when the heavy cost of maintaining a macadam road was taken into consideration, viz., 2s. 9d. per yard. Comparing that with the first cost and maintenance of granite, asphalt, or wood, the price was outrageous, and he thought, in the interests of the ratepayers, the authorities who had the control of the Thames-embankment ought to substitute a more enduring and less costly material than macadam the next time repairs were needed. His experience upon this subject had been rather large, having been connected with municipal work for a very long time, and therefore he had prepared some figures showing the cost of different pavements and their relative advantages and disadvantages. In considering pavements, there were several necessary essentials; in the first place the pavement should be sanitary, and in the next place durable and economical. No doubt there were different ways of viewing the expression "economy." The pavement should also be easily cleansed, non-slippery, noiseless, easy of repair and easy for travelling. The advantages of asphalt as laid by the Val de Travers Co., the Limmer Co., and the French Co., from a sanitary point of view, were that it was impermeable, non-absorbent and non-odorous. It was easily cleaned by washing, squeegeeing, brooming, or by street orderly boys. It was very durable because of its absolute homogeneity and great hardness, and was easy of

Material.	First Cost.	Repairing per yard per annum during 15 years.	First cost and maintenance during whole period.	Average price per square yard over whole period.	Average duration with slight repairs.
ASPHALTE, 2½ in. thick, on 6 in. concrete.	13/6 (with two years' guarantee).	1/- (-3 to 1/9)	29/6 per yd.	1/3	In main thoroughfares, 17 to 18 years. <i>Examples.</i> *CHEAPSIDE AND POULTRY.—First laid 1870. Traffic unstopped during 18 years, then re-laid. *OLD BROAD-STREET.—Traffic unstopped during 17 years, then re-laid. *THREADNEEDLE-STREET.—Laid May, 1869. Re-laid 1893, after 24 years wear.
GRANITE, 9 in. × 3 in., on 6 in. concrete.	14/6 old price. (18/4 present price), with five years' guarantee. 16/9	... ...	nett 16/6 17/-	{ -/7¼ old price, or -/9½ present price. { -/9 old price, -/10 present price.	20 to 25 years. <i>Examples.</i> GRACECHURCH-STREET.—25 years wear, three relays. HIGH HOLBORN, 1857.—23 years wear. SMITHFIELD.—Re-laid after 20 years. Renewed for further 10 years.
WOOD, on 6 in. concrete.	8/- 8/6 if creosoted, with three years' guarantee.	-/c½ (-/7 to 1/-)	23/3	1/4½	9 years.

* The streets were laid with Val de Travers Asphalt.

repair, as small sections could be cut out and replaced, being usable immediately it was cold. It was easy travelling, as there was no rumbling, no friction, and it was always tidy. The disadvantages were that it was noisy (which perhaps might be overlooked) and slippery, which defect might be remedied by constant washing. Once get rid of dirt and you get rid of slipperiness. If they could ensure a constant supply of water such as had been referred to, the streets of London would be as clean as those of Munich, Berlin, and other places. The advantages of granite were durability, economy, adaptability to steep gradients and heavy traffic, especially for tramway work, and good foothold for horses. The objections to granite were difficulty of cleansing, owing to the joints holding the dirt, its noisiness and greasiness in dirty weather. The advantages of wood were noiselessness, safety of travelling (except in frost) and adaptability to fairly steep gradients. The objections to wood were, he was sorry to say, very strong, because he noticed that wood paving was increasing rapidly in the metropolis; the first was that it was insanitary owing to its absorbent character, especially the joints, from which bad smells arose. Everyone knew that wood rolled and wore unevenly. The next objection was the difficulty of cleansing; dirt adhered to the fibre of wood and saturated it. It was also slippery in dirty weather. In the battle of pavements he took it that granite was becoming a thing of the past, so that in the future it would be a question between asphalt and wood. Asphalt cost more by $4\frac{1}{2}$ d. than wood. The question naturally arose,—What are the advantages of these two pavements? The cost of cleansing asphalt, as compared with wood, more than made up this difference of $4\frac{1}{2}$ d., and it would last from 17 to 18 years. He had brought a specimen, which had just been taken up from Throgmorton-street, which had been down for 24 years; but in Old Broad-street the asphalt had to be taken up and relaid after 17 years. In Cheapside it had been down for 18 years. The life of granite was from 20 to 30 years, according to the traffic over it, and the average life of wood was only 9 or 10 years. On the score of hygiene, asphalt held the first place, owing to its being so readily cleansed. [Mr. Bridgman submitted a Table (see p. 75) showing a comparison of the cost of the three chief pavements.]

Mr. TRENNER could not altogether agree with the table of Mr. Isaacs, where asphalt was placed third for economy, and granite first, because, in view of economy, one had to consider something more than the mere cost of making and repairing the road—there was the question of wear and tear of the brain and nerves. In Berlin and Germany asphalt was being largely employed. The Germans, who are practical people and took care of the pounds, shillings, and pence, were making nearly all the roads with asphalt. Personally, he preferred asphalt, on

account of its suitability for general purposes and the facility with which it could be cleansed. The whole of the Strand could be cleansed by a gang of boys, but this could not be done if wood or stone were used. No doubt there was a difficulty in streets where tram-lines existed, but in streets where there were none, asphalt could be used. With regard to horses slipping, he thought this might be remedied by the use of a particular kind of shoe, or a liberal supply of water.

Mr. CHRISTY said he should be glad if Mr. Isaacs would give them some information as to the cambering of the different pavements. It was well known that at the present time the same form of roadway was adopted as had been in use for hundreds of years, and he should be glad to hear which kind of pavement would give a flat road. No doubt it was necessary with the old Roman roads to make them so that the water would run off, but this was not now required owing to improvements which had taken place. On London Bridge there was not a single drain.

Mr. STEVENSON said although the reader of the paper seemed positively to have exhausted the subject he wished to record his opinion in favour of wood. At South Kensington a census had been taken among drivers of different vehicles upon the subject, and between 80 and 90 per cent. voted in favour of wood. He was afraid that, for London, asphalt was much too slippery, and until a new horse shoe was invented he did not think it would be wise to reverse the policy of wood pavement for asphalt. The fact that the use of wood was increasing to an immense extent showed that there was some practical benefit in it.

The CHAIRMAN hoped that on the next occasion someone qualified to speak on the question of shoeing of horses, would favour the meeting with a few remarks. He did not know whether the shoe used in Vienna in the winter was different from that used in the summer, but, if so, this would make all the difference between being practical and unpractical. In Russia a different shoe was used in the winter. He knew that in London horses were sometimes shod in the winter in a way which local surveyors would not approve of, if they understood it.

Col. RICH observed that in the American exhibition of 1876 a shoe was exhibited which enabled a horse to travel very well on ice. This shoe, which had india-rubber studs, had been largely adopted abroad, and was known as the Charlier. As to the question of economy of the different pavements, he thought economy might be looked at in two ways, first, what it cost to make the road; and, secondly, what it cost to travel upon. When he first came to London, now some 30 years ago, an ordinary vehicle for travelling on the pavement lasted about 8 or 10

years, while on macadam roads in the suburbs it lasted from 20 to 25 years. On an asphalt road he believed the same vehicle would last 50 years.

The further discussion was then adjourned until Wednesday next, 20th December.

Miscellaneous.

FINANCES OF THE CHICAGO EXHIBITION.

In ascertaining the total cost of the World's Columbian Exposition, there have to be considered the grants made to, and administered by, the National Commission and the Board of Lady Managers, as well as the revenues raised and expended by the Exposition Company, the Chicago Corporation, which, conjointly with the National Commission, organised and controlled the Fair. There is also to be reckoned the grant of \$1,500,000 (£300,000) made by the United States Government for the exhibit of the departments of State.

The accounts of the Exposition Company have been published in full detail. Their sources of revenue were, a grant from the City of Chicago, the subscriptions to the company, a grant from the United States Government, together with the receipts from admissions, concessions, &c.

It will be remembered that a sum of \$10,000,000 (£2,000,000) had to be provided before the Exhibition was assigned to Chicago. The amount actually paid up was in excess of this, and amounted to \$10,600,000 (£2,100,000). Of this the City gave \$5,000,000, while the amount subscribed by the stockholders was \$5,600,000 (£1,100,000). In the spring of 1893 an application was made to Congress to grant or lend a sum in aid of the Exhibition, \$5,000,000 (£1,000,000) being suggested. A grant of \$2,500,000 (£500,000) was made, and it was decided that the money should be paid in a special coinage, known as souvenir half-dollars. It was estimated that the coins could be sold at a dollar apiece, so that the grant would be really equivalent to \$5,000,000. At a later date, the United States Treasury kept back out of this sum the amount required for the expenses connected with the awards, so this portion of the grant has really to be credited to the National Commission. The amount realised by the company was under two millions and a half (\$2,448,000). The receipts from admissions were \$10,626,330 (£2,125,500); from concessions, \$3,700,000 (£740,000); miscellaneous receipts and interest produced \$770,000 (£154,000). The total receipts were \$28,151,168 (£5,630,200). The expenses are summarised under the heads of—Construction, \$18,323,000 (£3,664,500); preliminary organisation,

\$90,674 (£18,000); and general expenses, \$7,127,240 (£1,425,000). The total expenditure up to the closing of the Exposition was given as \$25,540,500 (£5,110,000).

It will, therefore, be seen that, treating the subscriptions to the company and the grants from the city and the State as gifts, not as loans, the Exhibition was a considerable financial success. There was, at the close, actually a balance of two million dollars, a large proportion of which is available for the subscribers, who certainly never expected to receive any of their money back.

No account appears as yet to have been published of the expenditure of the National Commission and of the Board of Lady Managers. It is stated that the Federal Government appropriated in all \$1,025,000 (£205,000) for the purposes of the Exhibition.

The total outlay upon the Chicago Exhibition may be taken as about five and a half millions sterling, of which it may be said, roughly, that over three millions were earned by the Fair, over two millions subscribed by Chicago, and a quarter of million provided by the U.S. Government.

THE BEET SUGAR INDUSTRY IN RUSSIA.

The beet industry is one of the most important branches of agriculture and manufacture in Russia, and beet sugar not only supplies the whole wants of the Russian Empire, but is exported in very considerable quantities to Austria, Germany, and other countries. The United States Consul-General at St. Petersburg says that the cultivation of beets took its rise in Russia at the beginning of the present century, simultaneously with its introduction into Western Europe. The Government from the first has taken an exceedingly active interest in this industry, and it has been strongly supported by the several agricultural and economic societies of the empire. To the first organisers of beet plantations and sugar factories, handsome prizes in money and in Government concessions were awarded; in fact, this industry has been in every way encouraged, supported, and patronised by the Government. The varieties of beets grown in the empire have their origin very generally in France and Germany; of these the French appear to contain the greatest quantity of saccharine matter, whilst the German varieties will produce the largest number of bushels per acre, the difference in the latter respect being about 25 per cent. Great care is taken in preparing the soil for beets. The field is twice ploughed, the first time from seven to eight, and the second from ten to twelve, inches deep. If the beet crop follows cereals the first ploughing is done immediately after harvest, and the second just before frost sets in. The implements used in working beet fields are generally of very good construction, sometimes foreign made,

and sometimes made in Russia after foreign models. The fields are sown generally from the first to the last day in April, according to local conditions of climate and soil. The seed is generally soaked in water, and then sown in rows—about twenty to twenty-five pounds of dry seed per acre. When the beet sprouts show three or four leaves the plantation is weeded, and at the same time the soil is loosened with the aid of a light hand machine, called *motyga*, care being taken to soften only the upper layer of the soil. The superfluous plants are afterwards weeded out, so that those remaining are from ten to twelve inches apart. The weeding and loosening are repeated five or six times, until the beet leaves cover the fields. The harvest begins generally in the last days of August, and ends about the 1st of October. The crop is gathered with the aid of a hand spade, or a two-pronged fork specially prepared for the purpose. When the beet is taken out of the ground it is cleaned of earth and topped, the small portion of the root also is cut away, great care being taken not to injure the bulb proper. The beets are then carefully piled on the field and covered. When great quantities are grown the crop is preserved as follows:—Ditches are dug from two to six feet wide, according to requirements, about one hundred feet long, and generally about two feet deep, into which the beets are piled until they are about two feet above ground. Sometimes the beets are heaped up on the unprepared ground. In both cases they are covered with straw, and then banked up with earth, and that the temperature in the beet pits should not be too high suitable openings are made, and wooden or straw ventilators introduced. The harvest of beets varies greatly in different years, according to locality, climatic conditions, and methods of cultivation. The crops are best in the South-Western Governments of European Russia, notably those of Kharkov, Bessarabia, and Poland. In the Polish plantations, for example, an acre yields on the average about six English tons of beetroots, and on some of the plantations as much as fourteen tons. The crop is more uniform in Poland than elsewhere, on account of the better methods of cultivation. The cost of cultivation is considerable, as beets require, during their entire growth, very considerable attention. The Imperial Ministry of Agriculture has furnished data showing the cost of growing this crop in the Governments of Kiev, Podolsk, Volyn, Kharkov, and Koursk. In general it may be averaged at about £3 15s. per acre. The cultivation of beets in Russia is said to have had a very beneficial effect upon agriculture in general throughout the empire by introducing improved types of machinery and farming implements, not only on large estates, but on peasant farms as well. In the amount of production, and in the value of the output of the factories, the beet sugar industry is one of the most important in Russia. The annual product of raw sugar alone, calculated from data covering the last five years, amounts to 955,000,000 lbs., valued at £12,000,000

sterling. As regards the quantity of sugar manufactured annually, Russia ranks fourth among European nations. As regards the quality of the raw sugar produced by the Russian factories, it is said to differ very little from refined sugar, and to surpass the raw product of foreign manufacturers. In the manufacture of the sugar very few factories at the present time are using the former centrifugal machines or presses, the diffusion process being universal. In 1890 and 1891, for example, there were 215 sugar factories, with 2,792 diffusion vats of different capacities, averaging about 444 gallons per vat. The purification of the juice, by diffusion or pressure, from the pulp and parings, previous to their subjection to straining or saturation, is now performed almost universally by filtration. Some works purify the juice chemically with the aid of sulphurous acid, instead of the more general means of saturation with the carbonic acid. The mechanical filtration of beet juice, purified by saturation, is also becoming more frequent, thus making a great saving in bone black, which in many factories is now only used for purifying the syrups. One of the most important improvements made in the methods of evaporating beet juice in boilers with exhausted air consists in the enlarging of the heating surface of the apparatus by converting them from double-acting into triple, quadruple, and quintuple-acting apparatus, with the view of economising fuel. One of the most valuable by-products in the manufacture of beet sugar is molasses, which in the early days of this industry was a positive burden to the manufacturer. Later it was used as a fertiliser, and to some extent as food for cattle. Now, however, the works are able to extract about 50 per cent. of crystalline sugar from this mass. It is also used to a large extent in the manufacture of spirits. In 1891, there were seventeen special sugar refineries at work in the empire, treating raw sugar made at other factories. The revenue derived by the Government from the taxation of sugar in Russia is estimated at an annual sum of £833,000.

General Notes.

COPENHAGEN EXHIBITION OF INVENTIONS.—The Copenhagen Industrial Society propose, with the co-operation of the Copenhagen Patent-office, to arrange a special exhibition of such new inventions as may be considered likely to be used in Denmark, Norway, and Sweden, and especially such as it must be supposed will be of interest for the handicrafts and industrial establishments of these countries. No charge will be made either for space or for motive-power, which the Society supplies. The Exhibition will be opened on Friday the 5th January, 1894.

AUSTRALIAN MARBLE AND BUILDING STONE.—New South Wales possesses an abundant supply of all the various kinds of stone and other materials, required for the building and adornment of its cities. Marble limestone is found in great masses near Wallerawang, Bathurst, Molong, Marulan, Tamworth, and Kempsey, localities which are all within convenient distance of the great arteries of communication, and it is obtainable in all its different varieties. Marble quarries have been opened at Cow Flat, Marulan, Wallerawang, Orange, and Tamworth, but only two or three are at present being worked. Granite is found near Goulburn, Moruya, Montague Island, and Trial Bay, as well as at many other places throughout the Colony. Most of the granite hitherto used in Sydney has been obtained from Moruya, a port about 180 miles south of Sydney. The Hawkesbury formation, over which the City of Sydney is built, provides the city with an inexhaustible supply of sandstone, of the highest quality for building purposes. This material is admirably adapted for architectural effect, being of a light colour, fine grain, and very easily worked. The beauty of Sydney street architecture is largely due to the free use of this excellent sandstone. Bluestone, which is extensively used as road metal and for the ballasting of the railway lines, is obtained at Kiama, Prospect, Pennant Hills, and Bowral. This stone has not yet been used to any extent for building purposes in Sydney, but is largely so employed in Melbourne.

SYDNEY WATER SUPPLY.—The Metropolis of New South Wales, together with its extensive suburbs, possesses a most complete system of water supply, and when the sewerage works are complete, Sydney should become one of the healthiest cities in the world. The source of the water supply is the united waters of the Nepean, Cataract, and Cordeaux, mountain streams draining an area of 354 square miles, fed by the abundant rain which falls along the coast district west of Wollongong. The water is intercepted at a height of 437 feet above the level of the sea, and flows through a series of conduits—partly tunnel, partly open canals, and in places wrought-iron aqueducts—to Prospect Reservoir, a distance of 40 miles from the farthest source of supply. Here an impounding reservoir has been constructed capable of holding 11,000 million gallons, of which nearly 7,000 million will be available for supply, the remainder being intended as a settling area. The top water at Prospect Reservoir is 195 feet over high water in Sydney Harbour. From Prospect the water is led through open conduits for a further distance of $4\frac{3}{4}$ miles, whence it is taken to the Crown Street Reservoir, in Sydney, a distance of 16 miles, in iron pipes. The conduits above Prospect Reservoir have a capacity of 150 million gallons per day, and for ten miles below this reservoir the capacity of the canals and pipes equals a maximum of 50 million gallons, while for the last eleven miles the

water flows through 48-inch and 42-inch cast-iron pipes, having a capacity of 17·5 million gallons daily. The Prospect Reservoir covers an area when full of 1,261 acres, or nearly two square miles, and has a capacity of 10,812,313,000 gallons. The dam, which is 7,300 feet long, 30 feet wide on top, and is carried to a height of 84 feet at the centre, contains some 2,316,500 cubic feet of earthwork. The water face is covered with heavy bluestone pitching. When the dam is quite full 6,744,343,000 gallons are available by gravitation.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

DECEMBER 20.—Adjourned discussion on Mr. LEWIS H. ISAACS' paper, "Carriage-way Pavements for large Cities." SIR BENJAMIN BAKER, K.C.M.G., F.R.S., will preside.

Papers for meetings after Christmas:—

"London Coal Gas and its Enrichment." By PROF. VIVIAN LEWES.

"Automatic Balance of Reciprocating Machinery, and the Prevention of Vibration." By W. WORBY BEAUMONT.

"White Lead Substitutes." By A. P. LAURIE, M.A.

"Experiments in Aeronautics." By HIRAM S. MAXIM.

"Automatic Gem and Gold Separator." By WILLIAM S. LOCKHART.

"The St. Pancras Electric Light Installation." By HENRY ROBINSON, M.Inst.C.E.

"Electric Signalling without Wires." By WM. HENRY PREECE, F.R.S.

"Modern Development of Illustrated Journalism." By HORACE TOWNSEND.

"The Adam Architecture in London." By PERCY FITZGERALD.

"Pewter." By J. STARKIE GARDNER.

"Railway Extension in India." By JOSEPH WALTON.

"The Petroleum Fields of India: their Present Condition and Probable Future." By R. D. OLDHAM, A.R.S.M., Superintendent Geological Survey of India.

"Indian Currency." By J. BARR ROBERTSON.

"Telegraphic Communication between England and India: its present Condition and Future Developments." By E. O. WALKER, M.Inst.C.E., C.I.E.

"Chota Nagpore: its Mineral Wealth and its Industrial Resources, and its value to India." By J. F. HEWITT.

"The Water Supply and Sanitation of the North-Western Provinces and Oudh." By SIR AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieu-

tenant-Governor of the North-Western Provinces and Oudh.

"Experiences at the Court of His Highness the Amir of Afghanistan." By JOHN A. GRAY, late Surgeon to the Amir.

"The Forthcoming Antwerp Exhibition." By EDOUARD SÈVE.

"Morocco." By Captain ROLLESTON.

"Paraguay." By A. F. BAILLIE.

INDIAN SECTION.

The meetings of this Section will take place on the following Thursday Afternoons, at Half-past Four o'clock :—

January 18; February 15; March 8; April 5, 26
May 24.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on the following Tuesdays, at Half-past Four or Eight o'clock :—

January 23; February 20; March 6; April 17;
May 1, 29.

APPLIED ART SECTION.

The meetings of this Section will take place on the following Tuesday Evenings, at Eight o'clock :—

January 30; February 13, 27; March 13; April 10;
May 8.

CANTOR LECTURES.

The following courses of Cantor lectures will be delivered on Monday Evenings, at Eight o'clock :—

PROFESSOR FRANK CLOWES, D.Sc., "The Detection and Measurement of Inflammable Gas and Vapour in the Air." Four Lectures.

January 22, 29; February 5, 12.

HUGH STANNUS, F.R.I.B.A., "The Decorative Treatment of Traditional Foliage." Four Lectures.

February 19, 26; March 5, 12.

CAPTAIN W. DE W. ABNEY, C.B., F.R.S., "Photometry." Three Lectures.
April 2, 9, 16.

HENRY CHARLES JENKINS, A.M.Inst.C.E. "Typewriting Machines." Two Lectures.
April 30; May 7.

JUVENILE LECTURES.

Two lectures, suitable for a juvenile audience, will be delivered by WALTER GARDINER,

M.A., F.R.S., on "Plants: their Foes and Defences," on Wednesday evenings, January 3 and 10, 1894, at 7 p.m.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 18... Imperial Institute, South Kensington, 8 p.m. Prof. Wallace, "Agricultural Resources of Canada."

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. E. J. Castle, "The Valuation (Metropolis) Bill, 1893."

Cleveland Institute of Engineers, Middlesborough, 7½ p.m.

British Architects, 9, Conduit-street, W., 8 p.m.

Actuaries, Staples-inn-hall, Holborn, 7 p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. W. F. R. Weldon, "Crabs."

TUESDAY, DEC. 19... Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. E. B. Ellington, "Hydraulic Power Supply in London."

Statistical, Geological Museum, Jermyn-street, S.W., 7½ p.m. Dr. Hugh R. Jones, "The Perils and Protection of Infant Life."

Pathological, 20, Hanover-square, W., 8½ p.m.

WEDNESDAY, DEC. 20... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Discussion on Mr. Lewis H. Isaacs paper, "Carriage-way Pavements for large Cities."

Meteorological, 25, Great George-street, S.W., 7 p.m. 1. Mr. Charles Harding, "The Great Storm of November 16th to 20th, 1893." 2. Mr. S. Tomlinson, "Rainfall and Evaporation Observations at the Bombay Water Works." 3. Mr. A. E. Watson, "Changes in the Character of certain Months."

Geological, Burlington-house, W., 8 p.m. 1. Mr. Herbert Kynaston, "The Stratigraphical, Lithological, and Palæontological Features of the Gosau Beds of the Gosau District, in the Austrian Salzkammergut." 2. Prof. Edward Hull, "Artesian Boring at New Lodge, near Windsor Forest, Berks." 3. Mr. D. Telford Edwards, "Boring on the Booyesen Estate, Witwatersrandt."

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Mr. T. F. Smith, "The Ultimate Structure of Pleurosigma Angulatum." 2. Mr. J. W. Gifford, "A New Screen for Monochromatic Light."

Patent Agents, 19, Southampton-buildings, W.C., 7½ p.m. 1. Discussion on Mr. Fell's Paper, "Anomalies of the Swiss Patent Law Administration." 2. Mr. F. Walsh, "The Trade Marks Amendment Act, New South Wales."

North-East Coast Institute of Engineers and Ship-builders, Literary Society's Hall, Sunderland, 8 p.m.

THURSDAY, DEC. 21... Linnean, Burlington-house, W., 8 p.m. 1. Mr. H. N. Ridley, "Enumeration of all Orchideæ hitherto Recorded from Borneo." 2. "Hepatica Collected by Mr. W. R. Elliott in the Islands of St. Vincent and Dominica."

Chemical, Burlington-house, W., 8 p.m. Prof. Dobbie and Mr. A. Lander, "Oxidation Products of Corydaline."

Historical, 20, Hanover-square, W., 8½ p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

FRIDAY, DEC. 22... Japan Society, 20, Hanover-square, W., 8½ p.m. Mr. Ernest Hart, "The Celebrated Masters and Principal Schools of Japanese Lacquer."

Journal of the Society of Arts.

No. 2,144. VOL. XLII.

FRIDAY, DECEMBER 22, 1893.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be given on Wednesday evenings, January 3 and 10, by WALTER GARDINER, M.A., F.R.S., on "Plants: their Foes and Defences."

The lectures will commence at seven o'clock. A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received, and the issue will then be discontinued. Subject to these conditions, each member is entitled to a ticket admitting two children and an adult.

Chicago Exhibition, 1893.

MEETING OF THE ROYAL COMMISSION.

A meeting of the Royal Commission was held on Monday afternoon, 18th inst., at 4.15 p.m. Present: Sir Richard Webster, G.C.M.G., Q.C., M.P., in the chair; Sir Frederick Abel, Bart., K.C.B., F.R.S., Sir George Birdwood, K.C.I.E., C.S.I., Major-General Sir Owen Tudor Burne, K.C.S.I., Michael Carteighe, R. Brudenell Carter, F.R.C.S., Sir George Hayter Chubb, Francis Cobb, Professor James Dewar, M.A., F.R.S., Major-General Sir John Donnelly, K.C.B., Sir Henry Doulton, James Dredge, Francis Elgar, LL.D., John O'Connor, B.L., Florence O'Driscoll, M.P., Westby B. Perceval, Sir Owen Roberts, M.A., D.C.L., Sir Albert Rolliet, LL.D., M.P., with Sir Henry Trueman Wood, M.A., Secretary.

Proceedings of the Society.

SIXTH ORDINARY MEETING.

Wednesday, December 20, 1893; Sir BENJAMIN BAKER, K.C.M.G., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Baker, Albert Pomeroy, 57, Deansgate, Manchester.
 Brigg, Thomas H., Fairfield-house, Buttershaw, near Bradford, Yorks.
 Mitchell, Charles A., 16, Titchfield terrace, Regent's-park, N.W.
 Picard, Hugh Fitzalis Kirkpatrick, A.R.S.M., 59, Abbey-road, St. John's-wood, N.W.
 Thrupp, George Herbert, 425, Oxford-street, W.
 Vincent, T. J., Victoria-embankment (next Temple Station), W.C.

The following candidates were balloted for and duly elected members of the Society:—

Baines, Jervoise Athelstane, 32, Kensington-park-gardens, W.
 Crewdson, Wilson, The Barons, Reigate, Surrey.
 Master, John Henry, Montrose-house, Petersham, Surrey.
 Pomeroy, Frederick William, 1, Wentworth-studios, Manresa-road, King's-road, S.W.
 Sell, Henry, Purley, Surrey.
 Wedderburn, Sir William, Bart., M.P., 84, Palace-chambers, S.W.
 Whichelo, Matthew Anthony, Clydesdale, Bycullah-park, Enfield.
 White-Cooper, Alfred S. P., M.A., 49, Cornwall-gardens, S.W.

The adjourned discussion on Mr. Lewis H. Isaacs's paper, "Carriage-way Pavements for Large Cities," was resumed.

Mr. G. F. DEACON said, though he had not had much to do with street paving for the last few years, having had control, from 1871, for many years of the municipal engineering of the second city in the kingdom, he felt some title to speak on the subject. He agreed with a good deal the reader of the paper had said, and was glad that the subject had been introduced, because it was one which he thought required a little more exact handling by engineers. He was sorry that neither Mr. Druscombe, his immediate successor in office, nor Mr. Boulnois, the present City Engineer of Liverpool, could be present, but what he had to say would not be much modified by recent experience. People were too apt to think that pavements could be laid

by anyone, just as in old days it was supposed that drains and sewers could be constructed by anyone. The author of the paper had referred to the northern methods of paving, and more particularly to the method of asphalt grouting of the setts. He thought that the author had not fully investigated that matter. It was spoken of as being merely surface grouting. Anyone who went to Liverpool and examined the pavements, which had been laid there since the year 1871, would at once see that it was nothing of the kind. Without reference at this stage to the particular method in which the stone was used and dressed in that city, he would say, to begin with, that the grouting was not tar. It was soft pitch and creosote oil, brought to a certain temperature (not boiled), and laid over the surface of the stone truly, but in such a manner and at such a temperature that it sank to the bottom of the setts, and left no cavity whatever. Prior to the process round pebbles were brushed over the surface of the setts, and with the old-fashioned rammer, swung between the legs, were shaken down. This quickly disappeared, and further gravel, from a quarter of an inch to five-eighths of an inch, was similarly shaken down, until the joints were full and the setts firmly held. When done in that way the hot asphalt penetrated through every interstice, and the pavement was much less noisy than when grouted with a rigid material like Portland cement. With respect to grouting with Portland cement, which was common in London, that seemed to him to be a delusion. The cement or hydraulic lime, unless allowed to set for a lengthened period, was disintegrated under moderate traffic within a very short time, and the setts ceased to be steady; whereas the asphalt continued capable of flowing at all temperatures, and the result was that the setts although not rigid and excessively noisy were always firmly held, like the teeth of Mammalia in their elastic cementum. The Liverpool method, and many other facts relating to the subject of street carriageway pavements were given in a paper he wrote for the Institution of Civil Engineers in 1879. (Proceedings Institute Civil Engineers. Vol. lviii. Part 4.) Asphalt properly made and used never worked up in the way suggested. The gritstones, chiefly from the coal measures which were used in the north, he knew a good deal about, but as they were not likely to be used in London it was unnecessary for him to say more than that they were exceedingly useful in streets of moderate traffic and especially on steep inclines. But special dressing was generally necessary to keep the joints narrow. The word "cube" appeared to have been used to designate any sett. He did not understand the dimensions of the setts where only two were given; 9 by 4 possibly meant 9 inches deep by 4 inches wide. His experience was that setts which were not shorter than they were deep were not stable. Over and over again he observed that setts used in London were

often longer than they were deep, so that when a cart-wheel went over one of them it started a movement which had a great deal to do with the short life of a sett. The cost of maintaining sett pavement given in the paper had astonished him very much. It was stated as 3d. per yard per annum, although the particular place where this occurred was not given, but in any possible traffic—even with traffic amounting to half a million tons per yard width per annum—it seemed to be quite incredible, and certainly would not be so if the setts were of the best material and form, and were jointed in the best manner. In Liverpool the streets of heaviest traffic bore about 360,000 tons per yard width per annum. One street, where the traffic was 218,000 tons per yard width per annum, had a mean load amounting to 679 of a ton per wheel, including empties. That was a very great traffic indeed, and there were not many London streets which could compete with it. The actual cost in those cases of sett pavement upon Portland cement concrete foundation, jointed in the manner he had explained, was 14s. 10d. as original cost. The interest he took at 8d., and the sinking fund for reproduction amounted to only 6d., because the foundation was permanent, and the setts had some value when removed. The maintenance per square yard per annum was 1½d., and scavenging 2.4d. per annum. This last item was not included in the paper. The total cost per annum amounted to 11.25d. Comparing that with wood, the cost, worked out in the same way, was 2.23d. A remarkable example of a macadam carriage way laid where wood pavement had since been laid under heavy traffic, and maintained simply because it was in front of a hospital, when calculated in the same manner, cost 2s. 11¼d. per annum. He should be sorry if what the author had said with respect to the use of hydraulic lime for foundations deterred others from using it. The cause of the blowing of the hydraulic lime was not the asphalt, but must have been the use of the lime in an improper condition. He should be very sorry if engineers who had to do with carriage-way pavement adopted the dictum that it was necessary to have cement weighing 114 lbs. to the bushel; the proper weight of cement depended upon its age in a great measure, and also upon its fineness. Seventeen years ago he reported his conviction, as a matter of experience, that wood pavement ought to be laid without joints at all. He had not known that that had actually been done, but since then he was glad to see from the paper that it had been. He had tried the experiment, and was satisfied that it was a proper thing. Horses ought not to pull up at the joints. It had been stated that it was impossible, up to the present time, to maintain in good repair, for any length of time, those portions of a carriageway pavement which were in juxtaposition to tramway rails. In anticipation of the Liverpool tramways being transferred to the Corporation it, devolved upon

him, in 1877, to relay them; the system had been greatly extended by his successors, and he thought, if anybody would take the trouble to look at those rails, they would come to the conclusion that there were exceptions to the rule. He was speaking of tramways laid through sett pavements. The pavement was laid in the ordinary way, but the setts next to the tramway were specially dressed, and laid with almost no joint, the surface being thereby greatly increased, so that the wear of the sett itself would be greatly increased. That was not found to cause any difficulty with regard to the slipping of horses, because the setts were very narrow. They were so dressed that they were in absolute contact with the rail at the surface of the road, a little overhang being given for that purpose. It was true that setts would not wear quite so slowly as a tramway rail; but if some of the Welsh syenite setts were used, there was no appreciable difference between them in ten or fifteen years. The important point had been touched upon in the paper, viz.: the terrible evil of two authorities controlling the pavement of a single street, and he believed it to be practically impossible, where a company did the laying and maintaining of the tramway pavements between the rails, and 18 inches on either side, to maintain them in good condition. In Liverpool asphalt pavements had not been used, because it would be impossible to use it generally. The streets running east and west were nearly all steep, and it would be only possible to use asphalt on the cross streets running north and south, which would clearly be objectionable, as the changes of pavement for the same class of traffic ought to be as few as possible. Asphalt had undoubtedly great advantages, though its cost was probably the highest and would continue to be the highest, he was hopeful however that a satisfactory artificial asphalt would be produced. There were plenty of so-called artificial asphalts, but they could not at present compete in point of durability with natural asphalts, simply because the combination between the bitumen and the lime was less perfect. One most important point in regard to this great city was the cleansing of the carriageway pavements. He was glad the use of water had been mentioned, and that an opportunity had been given to remove some misconceptions which had existed upon that subject. Referring again to Liverpool, where the water works were in the hands of the municipal authorities, water for sanitary purposes was not charged for and was used *ad libitum*. The total quantity used was less on the average per year than one gallon per head for all kinds of municipal purposes, with the Vyrnwy supply now introduced, there was no longer any difficulty with regard to a plentiful supply; but the increase would not be important. Even with asphalt pavements all over the place the quantity of water required for municipal purposes would not amount to two gallons per head per day. That being so, he thought any dual system of supplying water separately for municipal purposes and for general

purposes was out of the question. The cost would be much greater, he believed, than that of bringing the water in the same pipes as the household water. He thought they ought not to pay for water for such purposes, or if it was paid for, the amount should be a small sum only. That, he thought, was one of the very strong arguments for doing everything one possibly could to get the waterworks of any large city into the hands of the municipality, and until that was done he thought water would not be used as it should be used for sanitary purposes.

Mr. A. J. BARBER (President of the Trinidad Asphalt Company of New York), said, with regard to the suggestions made by Mr. Isaacs on the use of the Trinidad asphalt pavement on the other side of the water, that it was almost like sending coals to Newcastle to talk about bringing pavements to this great city, but he had some figures which he thought were not without interest to those who had studied this subject. Mr. Isaacs had mentioned one company with which he (Mr. Barber) had had the honour to be connected for 15 years, which had made since then 6,431,791 square yards of pavement. Those figures related only to the work done prior to the 1st January, 1893, and during the present year the company had made upwards of a million yards, bringing the figures up to a total of 7,436,720 square yards, being the equivalent of a roadway 26 feet wide 48½ miles long, or more than sufficient to reach from London to Glasgow in a direct line. In addition to the work done by this one company there had been 29 other companies engaged, in more recent years, in the same work, and the aggregate of their work would almost equal the amount which had been done by this one company, giving altogether more than 14,000,000 square yards of pavement laid in 75 cities of the United States and Canada during the past ten years, or an amount of pavement which would reach from London to Edinburgh, or to Glasgow and back again to London. These figures were striking, but of course it would have to be remembered that in this country the cities were old and well paved, while in the United States they were modern. He would mention the city of Buffalo, with a population of about 350,000, as having special interest. In 1882 he had the honour of being present when the present President of the United States was Mayor of that city, and signed the first contract for 22,000 yards of pavement. There had now been laid in that city 2,432,000 odd yards during ten years, all on petitions of private owners. He had been able to obtain correct figures with regard to the rock asphalt pavement laid in Europe, which amounts to 2,223,617 yards. Of this amount, about one-half has been laid in Berlin, about 400,000 yards each in London and Paris, and in the remaining cities about 271,000 yards, showing that in Europe, since the first pavement was laid in Paris in 1854, only about one-seventh of rock asphalt pavement has been laid, as compared with the amount which has been

laid in the United States in 75 cities within fifteen years, or 2,000,000 compared with 14,000,000, and under 150 miles compared with about 900 miles. With regard to the way in which the asphalt might be distinguished, it might be described as an artificial bituminous sandstone. Of course, there was necessity for a first-class foundation, which was conceded by all engineers; and, as someone said a week ago, it was only a question of what the wearing surface should be, and what should be put over the foundation to take the wear. The hydraulic concrete foundation was theoretically the best. In New York a large quantity of pavement had been laid on old macadam pavement, and old stone pavement, which were treated first with the binder, as it was called, consisting of fine broken stone mixed either with tar or pure bitumen, whereby an even surface was obtained. On macadam the process had been similar. Where the binder was put upon the macadam and rolled and an even surface obtained, the wearing surface was put, which consisted of about 85 per cent. of sand, the remainder being Trinidad asphalt. During the first seven years the work was somewhat empirical, being merely rule of thumb; it was twist a little or pull a little, and it was all right or wrong according to the idea of the expert who happened to be in charge. Beginning with that year a thorough system of chemical examination was undertaken, and the company had now records going back to 1886, and of work done upon 1,100 different streets. With regard to the question of cost he would only say that it was customary in America to guarantee it for five years. In New York a 15 years' guarantee was given, but a five years' guarantee was included in the first price, although a reserve was made. The average price was three dollars, including a five years' guarantee. In the city of New York the figure might be taken at four dollars, covering the entire guarantee of 15 years; 70 per cent. was paid in cash, the remaining 30 per cent being reserved and paid after the expiration of a certain time. The cost was 1s. per yard per year, including first cost and guarantee. There was some variation in price depending upon the amount of traffic, but those figures might be taken as the average, and the standard. The distinctive feature of the pavement besides its cost was the fact that it was not slippery—not even as slippery as granite. The difference in per-centage was 41 per cent. In 1885, systematic observations were made in ten different cities, extending over 192 days, in which period over 800,000 horses were observed, and it was shown that on an average a horse travelled 583 miles before falling on the Trinidad asphalt, and only 413 miles before falling on stone. The reason for that was accounted for by what was put over the surface on which the pavement was made. In the year 1888, a very accurate and careful test was made to determine the apparent slipperiness of the pavement and the Trinidad asphalt in New York. Six young engineers were

stationed, three on each for a period of five weeks, being changed in alternate weeks. Every time a horse went by a punch mark was made on one slip. If a two-horse waggon went by it was punched on another slip, a loaded waggon being punched on another slip. The accidents were also punched according to three different methods: (1) when falling on their fore knees; (2) on their haunches; (3) a complete fall. In February 92,639 vehicles went over the Trinidad pavement; but only five accidents occurred, and not one was a complete fall. Three were on the fore knees, and two were on the haunches.

The CHAIRMAN asked over what length of road the records were taken.

Mr. BARBER replied about 200 yards of roadway was kept under observation. On the rock asphalt pavement, the record showed that out of 77,998 vehicles which went over the pavement, 307 accidents occurred to horses, of which 49 were falls on the fore-knees, 61 on the haunches, and 197 complete falls. An effort was made by the company, of which he had spoken, to introduce this pavement into Paris and Berlin, and a tentative negotiation was also made for London in 1886. The efforts in Paris and Berlin were unsuccessful, though he did not know the reason for this. No doubt one explanation was, that the effort in Paris was made on the Rue de Rivoli, where it was said that 41,000 horses passed over the pavement in front of the Hotel de Ville per day, though, from observations which they took, the number was only 17,000. Anyhow, this was three times greater than in America, and in Gracechurch-street the traffic was simply a little over 5,000.

Mr. EDMESTON was glad to hear what had been done in America. With regard to the work which was done in the Rue de Rivoli, it appeared that, three months after the pavement had been laid, it began to give, and in nine months it had to be pulled up and relaid with rock asphalt. The reason the material did not appear to answer was because it did not do for streets over which there was a large traffic. No doubt it did very well for streets in which the traffic was small. He could not agree with Mr. Barber that the traffic in the Rue de Rivoli was greater than in Gracechurch-street. The proper way to lay wood pavement was to lay the blocks as close as possible; it was a mistake to lay it with joints wide apart so that the water could get down. In his own district of Paddington they began to lay wood paving, and he obtained certain blocks of wood from streets in London which required to be renewed, and upon sending them to Dr. Sedgwick Saunders that gentleman said that the blocks were saturated with organic matter, chiefly of urine and horse dung, especially the upper portion. Some were dried and decayed, and others had the appearance of a growth of fungi. He further stated that any wood soaked with street

refuse must invariably contain fungus spores. Dealing with side streets Dr. Saunders said he considered that they should be well swept, but if the sun did not penetrate the streets the wood would decay more quickly, and he pointed out that water should not be allowed to get below the joints to stagnate. With regard to what had been said about tramways he thought it was perfectly true that asphalt would not do to lay next the rails. One of the asphalt companies had been put to the cost of some thousands of pounds for maintaining asphalt laid in conjunction with the rails. Granite setts did very well. In Amsterdam tramways had been laid in the asphalt without having any bottom to them at all; they had a sort of inverted trough bedded in cement level with the asphalt, and it was found that it did not move in the slightest degree. It was thought very likely that this plan would be found to answer very well. He thought every care should be taken if there was the slightest movement in the rail, because it would let the water down, and so break the junction, in which case nothing could cure a defect of that kind. He produced a sample of the asphalt which had been laid in Paris.

Mr. BARBER said he did not think this was a fair sample of what was now being laid. The gentleman who did the work in the Rue de Rivoli was selected more for his knowledge of the language than for his practical experience. No doubt some of the material which had been used was not satisfactory, but a very different state of things now prevailed.

Mr. A. RIGG said that for any asphalt to be successful the surface must have a succession of hard and soft points, or a succession of channels or ridges. If this plan were adopted, accidents would be entirely prevented. It was not easy to get across asphalt or wood if grease was on the top, but with the ridges which he had mentioned this was to some extent obviated. Mr. Barber had described an asphalt made of sand. The asphalt was practically no more than a matrix to hold the sand.

Mr. DEACON said in most of the streets in London, where wood pavement was kept in good condition, the wear was rather the wear of the gravel held in a matrix of wood than the wood itself, and upon this he could not help saying that a good deal of harm was done in London by the size of the gravel put upon the wood pavement. He had often seen stones used larger than pigeon's eggs. In many instances the stones were not crushed in the first instance; they were beaten into the matrix of wood, and after a time they became broken and worked out, leaving a rotten place in the wood, which after a time formed the nucleus of a large basin. The pavement if gravelled properly was delightful in all senses except one, viz., a sanitary sense.

Mr. WALTER F. REID said if a wooden block which had been used for some time in London were examined, it would be found that the fibres were not vertical but horizontal. It was noticeable how horses slipped after the pavement had been in use for some time. Everybody would agree that the foundation was the most important part of the work, for without a good foundation the upper surface could not be kept in good condition. One of the earliest examples of wood paving was that of Nineveh, where asphalt was used, but it was used under the stone; it was carried under the walls of the adjoining houses. They laid the bitumen first, and then the pavement, and put the houses on the top. For clearing the streets from water large underground cavities or storm overflows, as they would now be called, were used, which were lined with bitumen. Whether a concrete foundation was used under wood or asphalt he agreed with Mr. Deacon as to what he said about blowing; if the concrete blew it was not good for anything; it was either badly made, or the ingredients were bad; he had no doubt that a good concrete could be made of lias. The reason it was seen more under asphalt than under wood was because asphalt rose up on foot pavements. There were often seen a number of cracks in the asphalt which were due to the construction of the concrete underneath. Everyone knew that it contracted, to some extent, when it became dry, and this carried the concrete with it. As to the weight of the cement per bushel, he quite agreed with Mr. Deacon that this was an illusory test. The weight per bushel was introduced by Mr. Grant some 35 years ago, but years afterwards he entirely abandoned it, not for the reason that cement became lighter, but that the finer it was ground the lighter it got. It had been completely abandoned in the German and French official test. The Germans retained for some time the specific gravity, but that was more to exclude slack and adulterated cement itself. The specification of a weight per bushel was not only useless but positively injurious, because a cement which weighed so much per bushel and ground extremely fine, as it should be ground, would lose several pounds, and therefore it was a premium on coarse grain and the wasting of material. With regard to grouting, if it were properly done it might be some use in cementing the stones together. The surface of a paving-stone was considerable, and if it were well cemented all round no doubt it would remain firm, but he had never yet seen a street in London grouted in such a way as to make it firm. The more water put upon is the better, but he had never yet seen any grouting done in the streets of London, so that the pavement was cemented together in one firm mass. Not very long ago the pavement on Waterloo-bridge was taken up, and it was surprising to find how firm the setts were held together. Under those circumstances, no doubt it was very difficult to take up a road and remove the setts which were defective, which added to the cost of repairs. The gritstone

was a concrete, and all species of asphalte were in themselves concrete, and there was no doubt that any asphalte used should be chemically tested in order to ascertain whether it was suitable or not. With regard to the stone used it would be very desirable to get a more accurate definition. The term "granite paving" was useless, because it defined nothing at all. All stones that were used for paving were called granite, whereas the true granite which contained mica was not a good stone for paving purposes, although it might be a useful stone for building purposes. They had heard nothing with regard to the strength of the various stones, and there had been no test put before them except that which was obtained by laying them down, and seeing how much or how little they cost, or how many horses fell down upon them. The speaker then described an apparatus, invented by Mr. Meade, the Surveyor to the Hornsey Local Board, for testing the relative merits of different stones, which he said was the best means of which he knew for testing macadam, otherwise than practically, on roads. With regard to the foundations of streets in London, they now had to use a substratum of concrete, which formed of itself a strong arch, sufficient to bear the traffic. In Oxford-street, he believed, it had happened that the earth fell away from the arch which was supporting the traffic, with the result that there was a hollow space underneath sufficiently large to enable a man to crawl in it. The arch was self-supporting, but underneath this cavity there was room for a mixture of gas and air, which might produce at any moment a most dangerous state of things, and lead to the surface of the roadway being blown up, with the traffic upon it. It seemed to him that it would be very much better, with regard to the main streets of London, if a subway were laid, of which the concrete basis for the surface of the pavement should form the arch, and in that to lay the pipes. He was aware that this had been tried, and difficulty had been found with regard to it, but he thought the chief difficulty had been with the companies who owned the pipes, and would not contribute towards the cost nor use the subway, although the plan had been adopted in other large cities with advantage, and he thought it would be well if it could be done at least in some of the most prominent streets in London. With reference to what had been said as to the pavement at Victoria Station, he thought something might be due to the fact that it was a railway station, as he had had considerable experience of Waterloo Station, where there was a stone pavement, which pavement smelt worse than most stables he had entered. Wood no doubt did absorb a very large quantity of organic matter which putrefied, with the result that the air of London was not improved. He could never understand why wooden blocks were impregnated with creosote, because, to begin with, it poisoned the air, and he thought the remedy was worse than the disease. The smell was fearful, and he doubted

whether it contributed to the life of the blocks. They were not down long enough to rot away. If blocks could be saturated with something which would keep the water out it would be an advantage, but it should be inodorous. With regard to the statement that asphalte was not acted upon by the temperature, he thought that that statement should be somewhat modified, for, during the last summer in London, he had seen a great number of places where the asphalte had buckled, and got into a most wavy condition, either because it had not been completely in contact with the foundation upon which it was laid, or because it had become too soft.

Mr. E. W. HUDSON wished to say a word respecting the use of syenite, as he thought that one objection to it would be that it was very slippery. Old-fashioned granite did not become so slippery as those granites which were syenitic. Generally, upon the subject of the paper, it afforded him pleasure to see the Society of Arts once more to the front with regard to this important matter. It was astonishing to him that it had been allowed to lie dormant so long. For more than 54 years the matter had been a serious one in London. Workmanship had, no doubt, improved; but as regarded material, we seemed to be confined to the same methods as were used in 1839, when Whitehall was first paved, and when, in Oxford-street, there were trials made of six or seven different materials placed in juxtaposition. With regard to the requirements of the public, it seemed to him that they wanted a noiseless pavement; and if they could get it by clamouring, they would have it. This demand for a noiseless pavement seemed to be met universally by Local Boards and others by putting down wood, which was a perishable and an unscientific material, and he had come to the conclusion that they were on the wrong tack in using such pavement. He thought that the carriage builder, and the farrier also, should look to the question of noise. To some extent this had been done, and they found the noiseless tyre on hansom cabs, although there was a necessity for the bell to warn one of impending danger. With regard to road surface Mr. Isaacs had said that it should be elastic. That he supposed was not to be taken absolutely literally, but, if so, he ventured to differ, and thought that a road surface should be as hard and as unyielding as one could make it, so that the wheel should not sink, and that if any elasticity was required it should be got from the vehicle itself. As to macadam, probably it would always be indispensable for the surface of suburban cross-country and pleasure roads on account of its safety in regard to foot-hold for horses. He believed it was the fact with regard to wood paving that in Fifth Avenue, New York, they were now going in exclusively for granite setts, and very large sums of money were being expended in abolishing wood pavement and putting down granite. Upon a

rough estimate, taking 60 miles of wood pavement laid in London, he considered that there was an extra cost of £112,000 per annum over what might be expected if granite setts had been used. In Paris the municipality refused to lay down wood unless one-third of the cost was contributed by the owners.

Mr. ISAACS, in reply, said the observations which had fallen from the chairman with regard to the state of things in London some 50 years ago, as to paving, were interesting, and the references to the wood paving then laid down in Holborn were particularly so. The change also to which the chairman had referred from wood to stone at Detroit was one of those things which no one could well understand, although the report of the Board of Public Works had attempted to account for it. The same remark applied to a like course which was being taken at Chicago. He could only account for it by the fact that America was a wood-producing country, and that it would have been natural for the inhabitants of those cities, as soon as the streets were formed, to avail themselves of the materials which were close to hand, thereby saving a very large amount. He was glad to find—turning to the observations of Mr. Bridgman—that they were both practically in accord as to the relative merits and demerits of the different styles of pavement, because Mr. Bridgman's experience, as a sanitary engineer, and also as Chairman of the City Sewers, was no doubt very large; and anything which fell from his lips must be received with a considerable amount of attention. He was pleased also to find that Mr. Bridgman recommended, as a remedy for slipperiness constant washing, or, as it was epigrammatically put by him, "Once get rid of dirt, and you get rid of slipperiness." Mr. Bridgman was followed by a member of the Board of Works for the Holborn district, who was quite right in introducing the question of wear and tear to the brain and nerves. He complained that regard was had only to the actual wear and tear of materials, and that human beings who occupied premises abutting upon streets where there was great noise had not any consideration, given to them. No doubt that gentleman was quite right, and that anything which interfered with the money-earning capacity of the human brain was a matter to be regarded in the question of the consideration of expense. Colonel Rich, he thought, was also right with regard to what he had said. Then turning to the discussion which had taken place that evening, he was glad to have heard Mr. Deacon's observations, because no doubt Mr. Deacon was a gentleman of very great experience. He should like to tell him, however, that he was a North countryman himself, and familiar with the pavements of the towns of Lancashire and Yorkshire. He was often at Manchester and Liverpool, and he had come to the conclusion that the system of grouting which prevailed in Lancashire, particularly in Liverpool and Manchester, was not the correct one.

He did not agree with Mr. Deacon's observation that the grouting used in London was not a good one and that he had never seen a grouting which did not become impregnated and decomposed. Reference had been made by a subsequent speaker to an instance of grouting which Mr. Deacon should have seen, and if he had seen it he (Mr. Isaacs) thought he would probably have altered his opinion—he referred to the grouting used in the paving of Waterloo-bridge. That paving, to the shame of the authorities, had been recently removed. One of the reasons given for its removal was that it would find work for the unemployed. He knew the unemployed found very considerable work in removing it. He had stood on Waterloo bridge, and had come to the conclusion that a worse case of slaughtering a fine pavement had never been seen, and the reason for its destruction he failed to see. If Waterloo-bridge had been a street, instead of having a balustrade on each side with the river east and west of it, and there had been houses occupied by people on each side of it, one could have readily understood, with such a large amount of traffic upon it there would have been a demand for a silent pavement, but in the case of a bridge with no houses abutting upon it, leading only to a road and a railway station, it was a gross and shameful waste of public money to destroy such a magnificent pavement, which had only been put down a few years ago. He was at a loss to understand why the difference between Liverpool and London pavement should be so great with regard to the cost of maintenance, but, of course, he accepted the figures given by Mr. Deacon, as they came from a gentleman who had so much experience upon the subject. In London, Col. Haywood, who was absolutely the best authority on subject, was of opinion that a good granite sett on a proper foundation could be kept in excellent repair at an average cost of 1d. per square yard superficial per annum. His own observations upon the matter had led him to the conclusion that Col. Haywood was not far wrong in this respect. Dealing with the remarks of Mr. Barber, he must admit that America was a very large country, and they were accustomed to very large figures in connection with the United States. Of course they could not hope to have such figures in England with regard to the amount of work done; but it did strike him as interesting to hear that in America 7,000,000 yards had now been made into 14,000,000 square yards of asphalt pavement, and that a length, which originally stood at 487 square miles, had now increased to 950 miles. He was sorry to hear it admitted that the material of which Mr. Barber spoke, somewhat naturally with great pride, when brought over to Europe and tested in the Rue de Rivoli, had not answered; but he was disposed to think that the composition of the material was not quite right. However, he hoped that Mr. Barber would not be disconcerted by his early failures. Mr. Edmeston had hinted that the asphalt referred to by Mr.

Barber was not suited for streets in which there was a great amount of traffic; and with this he was inclined to agree. The observations as to the mode of laying trams in Amsterdam were deserving of notice, as they showed a somewhat remarkable ingenuity on the part of the Dutch people. Near the City of Berlin they had laid a very hard and compact stone, a block of which was put upon each side of the tramway, the intervening space being laid with asphalte, which was found to be not at all interfered with by the traffic. The diagram on the wall showed another plan of laying out a road in connection with tramway metals, namely, putting 14 inches of mastic next to the tramway. The remarks of Mr. Reid as to the fibre of the wood not being vertical, but horizontal, accounted, to a large extent, for the absorption of foul and unpleasant matters. He was quite prepared to be convinced that his observations as to *lias* lime were wrong. Of course, everyone was guided by his own experience, and in the trial bit of asphalte which he laid in Holborn, he found that all his economical intentions were frustrated by the concrete blowing off. This was a costly experiment, which made a great impression on his mind, though he admitted that he was open to conviction. If he could be satisfied that blue *lias* lime was a proper material as a foundation for asphalte he should be ready to give it another trial. Another subject which had been touched upon was that of the shoeing of horses, and he was convinced that the system of cutting down the frog was a barbarous one, as it deprived the horse of the assistance which he would get if the frog were allowed to grow. To a certain extent the question of noiselessness might be remedied by making the vehicles noiseless. One speaker had referred to the trial which had been made in Glasgow recently of putting indiarubber tyres on omnibuses, and to this not having answered; but he thought they were now progressing in the direction of noiseless wheels. All of the best Hansom cabs in London were now tyred with india-rubber.

The CHAIRMAN, in proposing a vote of thanks to Major Isaacs, said that the paper, as he had anticipated in his opening remarks, had led to a very valuable discussion. They had had brought before them the experience of Liverpool by Mr. Deacon, and the experience of their American cousins by Mr. Barber, and experience in America and Great Britain might now be considered as common to both. The extent to which the asphalte was used in the United States was very considerable, in fact it would be almost sufficient to pave half the streets of London. He should be glad if the mileage of wood and asphalte pavement in London could be appended to the paper as it would afford most important information.

Mr. HUDSON said he believed that at present there were between 60 and 70 miles of wood pavement in London.

The CHAIRMAN said that Sir Joseph Bazalgette, in 1878, stated that there were only 22 miles of asphalte and 15 of wood, but this quantity must have been considerably increased. There were 280 miles of granite paving, the rest being macadam and gravel. With regard to the shoeing of horses he had taken the opportunity, when at the War-office that day, of asking what was being done in Germany, and he found that during the winter months studs were inserted in the shoes. If the studs were shallow and flat-headed, he thought they would be applicable in ordinary greasy weather in London.

The vote of thanks having been carried and briefly acknowledged, the meeting adjourned.

Mr. H. ALFRED ROEHLING, of Leicester, writes:—Mr. Isaacs's paper is a very valuable one, and I only regret that the author has not given statistics of the carriage-way pavements in some of the principal cities of the world, as it would have been very interesting to observe, which kind of pavement was most favoured in the various cities. Concerning the Table of comparative merits and demerits of asphalte, wood, and granite, I think that it might be taken to be fairly representative, and the conclusion to be drawn from it is that there is practically very little difference between these kinds of pavement, it being simply a question of locality. With this I fully agree, and I am of opinion that the particular needs of a particular thoroughfare require to be considered individually, and not collectively, with the rest of the town. This principle had not always been adhered to, and instances were not wanting where a particular kind of pavement had fallen into disrepute through being placed on a road for which it was not suited. I also think that, in some cases, the bad way in which a pavement had been laid had led to a wrong opinion being formed of it. Concerning street pavements in London it could not be said that they betrayed uniformity, and they were characteristic of the way in which London was governed at the present time. The difference between the cities of Paris and Berlin was very significant as far as the value of wood and asphalte for carriage-way pavements was concerned. In Paris the Municipal Council was strongly in favour of wood, and it had established an excellent system of laying down this kind of pavement by its own staff, which was specially employed for this purpose. I am informed that not only the Municipal Council, but the public in general is strongly in favour of wood in Paris, and if the authorities could satisfy all the wishes that had been expressed in this respect they would have to pave nine-tenths of all the streets with wood. In Berlin almost the reverse of this was the case. The authorities had tried wood there in various places, but had practically discontinued extending its use as it had not proved satisfactory. He believed a similar experience had been gained in other parts of Germany. I am of opinion, however,

that wood did not have a fair chance in Berlin, and in connection with this, I may be permitted to quote from a pamphlet on "The Streets of Berlin," which appeared last year, and was written by an official of the City Council. This gentleman remarked as follows: "It must be pointed out, however, that considering the very favourable results which have been obtained in Paris with wood pavement, the bad experience gained in Berlin with this kind of pavement is in the main due to the inefficient way in which it has been laid, so that it will not be possible to form a conclusive opinion at the present time." In connection with this, I have been informed that the use of wood may again extend in Berlin, as a change of opinion seems to be taking place. In conclusion, I quite agree with the author of the paper that the roadway of the future should necessarily be one that was elastic, noiseless, not too slippery, durable and satisfactory from a sanitary point of view.

Mr. ARTHUR VENTRIS writes:—I would ask, through you, to correct a wrong impression which might be gathered from Mr. Isaacs's valuable paper in citing the change of pavement, namely, from asphalté to wood, as an indication of the progress in favour of the latter. It became my duty, as surveyor to the Strand District Board of Works, to recommend this change, namely, from asphalté to wood, in Leicester-square and Cranbourne-street. The pavement laid some twenty-two years ago required reforming, the foundation being faulty. The recommendation was based on the "continuity of pavements" in this, as it should be in all main thoroughfares. This change was unanimously adopted by a Board who favour asphalté as a pavement wherever it can otherwise usefully be adopted. On the subject of cleansing, Mr. Isaacs undoubtedly points to the only satisfactory method, namely, washing; but I venture to question the statement that we wait for a supply of "dirty water." The roadways in the Strand District, stated to be ten and a quarter miles in length, and all courts, are thoroughly washed, a supply of water being given by the New River Company for this purpose through metered hydrants, laid down at the cost of the Board, representing upwards of thirty-seven million gallons per annum, at the small rate of 6s. per thousand gallons. The Strand between Burleigh-street and Temple Bar is washed daily. The cost, including labour, &c., I have found to be 46 of a penny per yard for washing, or about 1s. 1½d. per yard per annum on this thoroughfare, and in other thoroughfares apparently the cost is proportionate to the amount of traffic. If adjoining authorities adopted the same method, there would be substantially no mud in the streets. Cleanliness has also an important bearing on the question of the gradients suitable for wood pavements. Norfolk, Arundel, and Surrey-streets have gradients of from 1 in 20 to 1 in 15; all are paved with wood and washed three times a week.

The foothold in these thoroughfares is perfectly satisfactory.

Mr. W. H. DELANO, Director and Manager of the Compagnie Générale des Asphaltes de France, Quai de Valmy, Paris, writes:—I have received this morning (December 18th) your *Journal* of the 15th inst., and read with much interest the paper on "Carriage-way Pavements for Large Cities," by the eminent surveyor, Mr. Lewis H. Isaacs, whom I had the pleasure of meeting in this city some years ago, when he was comparing Paris methods of road-making with those of London, Berlin, and Vienna. It afforded me real pleasure, as an old asphaltér, to notice the stress that Mr. Isaacs lays upon asphalté as the material *par excellence* for hygienic roadways. Undoubtedly, were the narrow streets, bye-ways, blind alleys, and courts in London, in the poorer portions, paved with asphalté, the health of the inhabitants would be improved, and epidemics have less hold upon them, for asphalté harbours no morbid germs, and its surface can be cleansed daily, as readily as can a china dish. I wish respectfully to correct a slight slip of Mr. Isaacs' pen—page 69, first column, 35th and 36th lines, where he refers to asphaltés "from the Pymont and Gardebois mines, at Seyssel, in France." Now, Pymont is in the Department of the Ain. The Gardebois concession (113 hectares in extent) has for its official title "Gardebois," and is in the Department of La Haute Savoie, whereas Pymont is in the centre of the celebrated Seyssel concession (5,117 hectares in extent), which has for its title "Seyssel," shared by no one (see plan of concession, President Carnot's decree, &c.). The Seyssel concession cost my shareholders some £50,000. It is the biggest in France, and must not be confounded with other small mines. As a point of history, the first street in compressed asphalté was laid in Paris in 1854 (see page 82 of M. Malo's book, which I send for your library, with a little book of my own). The latter is the development of a paper read by me at the Institution of Civil Engineers ten years ago. I also send a sample of compressed roadway, laid three years ago, made of half Mons rock and half Seyssel, which has the advantage of not buckling under any atmospheric heat. It has a very fine grain. This mine of Mons is a new one, and has been worked exclusively for the last three years under M. Malo. The rock is now exported to London, Berlin, and New York, besides being daily used in Paris. The question of the nomenclature of asphalté products is important, and is specially treated in my little book. Some people—from interested motives perhaps—call Trinidad pitch, and even coal-tar, "asphalté." If you will consider the foregoing remarks as a contribution to the discussion, I shall be pleased.

LOUIS C. PARKES, M.D. (Medical Officer of Health for Chelsea), writes:—I regret that I shall unfortunately be unable to take part in the adjourned

discussion on Mr. Lewis Isaacs's paper, but I think that the following observations may be of interest to members of the Society. In my opinion Mr. Isaacs has hardly laid sufficient stress upon the sanitary aspect of wood carriage-way pavements, although he does not consider the use of such a material advisable in narrow streets, or even in comparatively wide streets where the height of the buildings which abut on the same prevents the free passage of air. I would go much further, and say that under existing conditions the paving of the main London streets with wood (*i.e.* those thoroughfares which are main lines of traffic), is a nuisance and a danger to the public health. As the traffic increases and as the buildings increase in height the nuisance will tend constantly to increase. We see year by year the houses flanking our principal streets being nearly doubled in height, but it is only rarely that there is any widening of the thoroughfare. Under these conditions the ventilation of the streets will deteriorate, whilst the filth deposited on the roadways will be continually augmented. There can be no doubt that the chief, if not the sole, cause of the nuisance are the horse-droppings. The organic liquids from these soak into and rot the top layers of the wood. The filth is never satisfactorily removed by sweeping, and those streets which are not periodically flushed by hose and jet are only really in a state approaching cleanliness after heavy falls of rain. During such warm, dry weather as the spring and summer of 1893, the putrid vapours generated on the surface of the wood pavements are constantly present in the atmosphere breathed by pedestrians in our most frequented wood-paved streets, whilst the wind, which should help to disperse the effluvia, raises the dried particles of horse droppings in whirls and eddies, and chokes our eyes, noses, and throats with dried stable dung. Many competent medical observers were of opinion that the state of the wood pavements was responsible for much of that sore throat which was so widely prevalent in London in the early part of the summer. There is a popular impression that stable smells are not unhealthy. This may be true of stables, and of the people who live over them, who become acclimatised, so to speak, to an atmosphere impregnated with ammonia. It is, however, no reason for converting our streets into foul smelling stables. It must be remembered, also, that the dung of horses fed on maize is far more offensive than that of horses fed on oats. The London General Omnibus Company's horses are fed on maize, and the practice is, no doubt, fairly general amongst the large London carriers. It is, at any rate, certain that the omnibus routes are far more offensive than those not traversed by these vehicles. On macadamised roads the horse dropping nuisance is much less than on wood. The earth on the macadamised roads becomes mixed with the organic filth, and quickly exerts its deodorising effects. On the wood pavements there is practically no earth with which the horse dung can combine. The dirt on the surface of the wood is unmitigated,

stale, stable dung. Now, as to the remedies, as except for sanitary reasons wood forms an almost ideal pavement, and it is not desirable to discard it altogether, without making an effort to improve the methods of its use. First and foremost, there is no reason whatever why the plan of intercepting horse dropping, practised in Germany, should not be adopted in London. A simple contrivance of the nature of a watertight bag, fixed under the vehicle, with an elongated neck, and mouth distended and fixed in such a position in relation to the horses' buttocks as to catch all the dung, would answer every purpose. I have seen one attached to a cart, and it is not unsightly, nor does it in any way incommode the horse. The use of such dung interceptors should be rendered compulsory for all London vehicles except taxed private carriages. This reform once introduced, the effect would be enormous and instantaneous. The wood and asphalted pavements would be always in a cleanly condition, free from foul mud, and from pungent dust. Road-cleaning could be largely dispensed with, and the wood pavements would have an extended life. The attentions of the road cleaners might be, with advantage, directed to the footways, which are now so much fouled by human expectoration, dogs' dung, dirty paper, and orange-peel. The cleansing of the footways is now a statutory duty imposed on the Vestries by Section 29 of the Public Health (London) Act, 1891; but it is not, or only very inefficiently performed. Failing the adoption of a radical cure, such as the above, then it is absolutely necessary that for the six summer months of the year, the wood paved carriage ways should be well flushed with water by hose and jet three times a week in all the main lines of traffic. In winter and in the less frequented routes, the flushing should be once a week, of course dependent upon the flushing produced by rainfall. This will necessitate the erection of standpipes at intervals of about every hundred yards, and the employment of a special staff of men by every sanitary authority in London. The expense of water, labour, and erection of standpipes will, no doubt, press heavily on the rates; but unless London is to lose its premier position as the healthiest and most cleanly capital in the world, the outlay must be faced, unless my first suggestion is adopted.

Mr. G. A. THRUPP writes:—The subject of "Carriage-way Pavements for large Cities" I consider has been put before us so ably by Mr. Lewis Isaacs that I can only desire to emphasise his remarks. The general substitution of asphalt and wood for granite and macadam has not only added years to the life of a carriage or cab by diminishing jolts, friction, and jars, and made it far easier for horses to draw their loaded vehicles, but it has made locomotion easier to those who formerly dreaded the daily inconvenience of being bumped and shaken in their journey into and returning from the City. The former experiences of fifteen years ago, when an

omnibus journey was so wearying, that the smooth roll of the tram-car made it welcome in every suburb, are no longer felt in our great thoroughfares. Therefore, tram-cars which monopolise the roadway need not be introduced into those parts of London where those obtrusive and wheel-wrenching rails would be most unwelcome. Such are some of the advantages of asphalt and wood carriageways. These pavements are slippery when very damp it is true, but not so bad as were the old uneven granite blocks—whilst horses certainly get accustomed to the smooth pavements more rapidly than the careless coachmen who cause most of the falls of their horses. It should be remembered that there is less wear to the horseshoes on these smooth elastic pavements, and the London farriers are able to, and do, use lighter shoes which, when grooved in the centre, as most carriage horses are shod now, enable the horses to tread with more security. The india-rubber pads also, that are now so much used beneath the frogs of the horses' hoofs, prevent slipping, not only in damp weather, but during the sharpest frost. I have never seen a horse fall where ordinary pains have been taken in driving him, and where also the shoe is grooved or has not been on the horse's foot so long that the under surface has become smoothly polished, and consequently slippery. These shoes worn as smooth as a skate are constantly to be seen upon cart horses drawing heavy loads; it is a most mistaken policy, a most false economy on the part of their owners, who delay to the last having a new set put on.

Mr. HUDSON has sent the following additions to his remarks on page 86:—The opinion of the actual durability of wood "pavement," entertained by the late Metropolitan Board of Works and the London County Council, is shown in the fact that all loans for such work must be repaid in five years. Major Isaacs puts asphalt before granite sets in regard to safe foothold, but if we take all weather states into account, I should certainly (as horses are now shod) reverse the order so given, and were rational shoes adopted, I should, on all accounts (except noise), place granite sets as *facile princeps*. In truth, it has been neglected in capitals of Europe for 25 years, and midland towns are far ahead of London, and without prejudicing other towns, I think Leicester, under the late Mr. Gordon's charge, is by no means last in excellence. There are a few good recent instances in London. I would put forward new Battersea-bridge with stone trams, by the late Metropolitan Board of Works; the courtyards of public buildings by Her Majesty's Office of Works, and Euston-station, as good work, and for ordinary streets, the work of the London Street Tramway Company in St. Pancras as sound and creditable. If 18s. 4d. per square yard is the present price, it suggests little demand as regulating price. Sound work ought to be possible at 15s. to 16s. The difficulty of removing the old sets of Waterloo-bridge this month is an argument against the theory that cement is destroyed by vibration, &c.

Recent quotation of prices for wood blocks received by St. Pancras Vestry were:—Yellow deal creosoted, £7 5s.; pitch pine, £9 17s. 6d.; Jarrah, £13 5s.; Karri, £13 10. I believe the renaissance of the art of paving will be in the direction of stone with trams for heavy traffic and the better construction of vehicles.

Miscellaneous.

MINERAL PRODUCTION OF ONTARIO.

The second report of the Ontario Bureau of Mines contains the following particulars of the mineral production of the province of Ontario for the year ended the 31st of October, 1892, which are quoted in the *Board of Trade Journal*:—

About 100 quarries have been worked, mainly for limestone or sandstone for building, mostly dimension stone (680,000 dollars' worth), and rubble (132,000 dollars' worth), the remainder heads, sills, and coursing stone. The sum paid in wages to workmen in these quarries was \$730,000, and the total value of the product was \$880,000. The lime burned last year was estimated at 2,600,000 bushels, valued at \$350,000, but the returns are incomplete.

Two-thirds or more of the cement made in Ontario is the product of natural rock; but Portland cement was begun to be made in 1891, when 2,033 barrels were made, valued at \$2.50 per barrel. This year the natural rock output is 7,977 barrels greater than in 1891.

Brickmaking is a considerable industry in Ontario. There have been no less than 161 returns made to the Bureau, of establishments producing in all 175,000,000 common bricks, of a value closely approaching \$1,000,000. Pressed brick shows a greatly increased output over 1891 of nearly 40 per cent., namely, 20,342,000 plain and 1,323,000 fancy; total value, \$233,600. There is a new pressed brick company operating at Port Credit, using the red shale of the Medina formation. The value of pottery made in 1892 was \$80,000.

Gypsum mining in the province shows only 72 per cent. of the output of 1891, being 3,870 tons, valued at \$14,100; but alabastine and plastic manufacture is considerably increased.

Owing to the low prices at which Florida phosphate of lime sold in European markets during 1892, the output of apatite in Ontario last year was extremely small. Only three mines were worked, and these to much less than full capacity, the total product being 2,381 tons, valued at \$23,810. In the years 1881 to 1885 (inclusive) the shipments of Canadian phosphate to Great Britain and Germany were 15,000, 17,000, 18,000, 22,000, and 24,000 tons respectively.

Only one Ontario mica mine was worked last year. Its output was seven tons, valued at \$1,500.

According to a report made by the secretary of the

Salt Association (Mr. John Ransford), the quantity of salt made in the province in twelve months, ended with October last, was 43,387 tons, valued at \$162,700.

On the subject of nickel, copper, and cobalt the report has this to say: The quantity of ore raised last year was 72,349 tons, and the quantity smelted 61,924 tons. Three of the four companies operating have erected Bessemerising plants, employed to enrich the matte; but only a portion of the matte is treated by this process. The quantity of ordinary matte produced at all the furnaces was 6,278 tons, and of Bessemerised matte 1,880 tons. The estimated metal contents of these mattes and their value at the works is thus given: Nickel, 2,082 tons, value \$590,902; copper, 1,936 tons, value \$232,135; cobalt, 8½ tons, value \$3,713. The value of the metal contents was thus \$826,750, nickel being 14.2 cents per pound, copper \$120 per ton, cobalt \$437 per ton. London quotations for nickel ruled steadily at 42 cents per pound, and New York 48 to 52 cents.

Gold mining was fairly active during the year, mostly in the way of development. The districts worked were Hastings County, East Algoma, and Lake of the Woods. Nine companies mined 3,710 tons of gold ore, valued at \$36,900. The Ophir Mine, north of Thessalon, was bought by a Duluth syndicate for \$100,000, and several shafts sunk with a good show. Treating works were being erected, to be ready in August. The Creighton Mine, west of Sudbury, had 63 men at work, and buildings were being erected. Three mines were being worked in Hastings, the pyritic ore being treated at one of them in a Crawford mill with satisfactory yield.

As one of the results of the depreciation of silver, nearly all the silver mines in the Lake Superior district have been idle all through 1892.

Notes on Books.

THE STUDIO: an Illustrated Magazine of Fine and Applied Art. Vol. I. London. 1893.

This monthly journal, which was commenced in April last, has now completed its first volume. Its contents are of varied interest, and the illustrations are plentiful. The mention of a few of the articles will give some idea of the aims and objects of this new addition to illustrated journalism. The volume opens with an article on Sir Frederic Leighton as a modeller in clay. Letters on artists' sketching grounds follow, and are continued in subsequent numbers, Holland and Spain being specially treated. Sketching from nature, art in photography, drawing for reproduction, artistic houses, paintings in Birmingham Town-hall, new gas-fittings, *technique* in glass painting, are some subjects out of many which are discussed in the pages of "The Studio."

A TEXT-BOOK OF TROPICAL AGRICULTURE. By H. A. Alford Nicholls, M.D., F.L.S., C.M.Z.S. London: Macmillan and Co.

This work owes its origin, in the first instance, to the public spirit of a colonial Government, that of Jamaica, in offering a premium for the best Text-book of Tropical Agriculture. The author was one of the competitors, and he received the award on the understanding that he fulfilled a promise to add further matter dealing more completely with cultivated tropical plants. His aim has been to produce something that would prove serviceable to peasant proprietors, to owners of small estates, and to intending settlers in the tropics. The book appears to have already met with considerable success, and not only in Jamaica, but in other colonies, where it has been officially adopted by the various local Governments. Dr. Nicholls has not been content to give his readers a mere compilation, but has set himself the task of recording the experience "gained by study, observation, and experimental cultivation." In Part I. he describes, in sufficient though not wearisome detail, the elements of agriculture, that greatest of all pursuits; and in the second he deals exhaustively with products of the soil in tropical regions—coffee, cacao, tea, sugar cane, fruits, spices, tobacco, drugs, cereals, and food plants. The work is dedicated to Sir Joseph Dalton Hooker, under whom Dr. Nicholls acted as Kew correspondent for Dominica.

THE YEAR-BOOK OF SCIENCE. Edited, for 1892., by Prof. T. G. Bonney, D.Sc., LL.D., F.R.S. London: Cassell and Company.

The editor explains that this the second "Year-book of Science" follows the same general plan as the first volume, and observes the same limitations of the subjects, but the area covered by these has been extended so far as could be done without a considerable increase in the number of pages. H. H. Hoffert, D.Sc., P. L. Gray, B.Sc., E. W. Maunder, F.R.A.S., and Charles Harding, F.R. Met. Soc., write on Physics; Professor W. Ramsay, Ph.D., F.R.S., Harold Picton, B.Sc., and Charles F. Baker, B.Sc., on Chemistry; G. T. Prior, M.A., Horace B. Woodward, F.G.S., R. Lydekker, J. W. Gregory, F.G.S., F. A. Bather, M.A., F.G.S., T. T. Groom, B.Sc., F.G.S., Thomas Hick, B.A., B.Sc., and Professor H. G. Seeley, F.R.S., F.G.S., on Geology and Mineralogy; G. Herbert Fowler, B.A., Ph.D., R. Lydekker, R. J. Pocock, and C. S. Sherrington, M.A., M.D., on Biology (animal); W. B. Hemsley, F.R.S., A.L.S., G. Massee, D. H. Scott, M.A., Ph.D., F.L.S., and Professor F. E. Weiss, B.Sc., F.L.S., on Biology (botanical).

CORRECTION.—Page 67, col. 2, Mr. Michie's estimate as to the life of wood pavement should read "seven to sixteen years," and not seven to ten years.

Journal of the Society of Arts.

No. 2,145. VOL. XLII.

FRIDAY, DECEMBER 29, 1893.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be given on Wednesday evenings, January 3 and 10, by WALTER GARDINER, M.A., F.R.S., on "Plants: their Foes and Defences."

The lectures will commence at seven o'clock. A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received, and the issue will then be discontinued. Subject to these conditions, each member is entitled to a ticket admitting two children and an adult. Tickets are now in course of distribution, and members requiring them should apply at once.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by members on application to the Secretary.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied post free for 1s. 6d. each, on application to the Secretary.

Proceedings of the Society.

CANTOR LECTURES.

THE ART OF BOOK AND NEWSPAPER ILLUSTRATION.

BY HENRY BLACKBURN.

Lecture I.—Delivered November 27th, 1893.

THE ILLUSTRATOR OF TO-DAY.

Education of the Artist—Drawing for Reproduction—Modern Methods and Requirements—Examples of Drawings for Reproduction, Good and Bad.

Eighteen years ago, in this room, the general question was discussed "whether, in the

matter of book and newspaper illustration, we are really 'keeping pace with the times'; whether those who provide the illustrations, which are tossed from steam printing presses at the rate of several thousand an hour, are doing the best work they can." The meeting was largely attended by experts, and the general conclusion arrived at was, that much remained to be done.

Thus in 1875 it was admitted, almost without dissent, that the system of illustrating books of travel and scientific research by means of wood engravings was "too elaborate and costly"; that, in consequence, there was much valuable material that never saw the light, and that in the case of news the public was continually deprived of what it would most care to see.

In the illustration of newspapers, it was further argued that there, should be a clearer distinction between fact and fiction, between illustrated news and pictures. The exact words may be thought worth repeating:—

"In the production of illustrations we have arrived at great proficiency, and from London are issued the best illustrated newspapers in the world. But our artistic skill has led us into temptation, and by degrees engendered a habit of making pictures when we ought to be recording facts. We have thus, through our cleverness, created a fashion and a demand from the public, for something which is often elaborately untrue.

"Would it then be too much to ask those who cater for (and really create) the public taste, that they should give us one of two things, or rather *two things* in our illustrated papers, the real and the ideal.

"1st. Pictorial records of events in the simplest and truest manner possible.

"2nd. Pictures of the highest class that can be printed in a newspaper.

"Here are two methods of illustration which only require to be kept distinct, each in its proper place, and our interest in them would be doubled. We ask first for a record of news and then for a picture gallery; and to know, to use a common phrase, *which is which*."

At the time referred to, drawing on the wood-block and engraving was almost universal—instantaneous photography was in its infancy, "process blocks," that is to say, mechanical engraving, was very seldom employed, and (for popular purposes) American engraving and printing was making great strides.

Let us now glance at some of the changes which have taken place in illustration (bridging

over a distance of nearly twenty years), and consider the work of the illustrator, the photographer, and the maker of blocks, as presented in books and newspapers at the end of 1893; speaking principally of topical illustrations, on which so many thousand people are now engaged.

It may seem strange at first sight to include "newspapers" in the title of these lectures; but the fact is that the weekly newspapers, with their new appliances for printing, and in consequence of the cheapness of good paper, are now competing with books and magazines in the production of illustrations which a few years ago were only to be found in books. The illustrated newspaper is one of the great employers of labour in this field, and distributors of the work of the artist in black and white, and in this connection must by no means be ignored. The Post-office carries a volume of 164 pages (each 16 by 22 inches), weighing from two to three pounds, for a half-penny. It is called a "weekly newspaper," but it contains, sometimes, 100 illustrations, and competes seriously with the production of illustrated books.

In the next lecture we shall see how the illustrations of one number of an illustrated newspaper are produced; what part the original artist has in it, what part the photographer, what part the wood engraver.

It was time, perhaps, that the "Society for the Encouragement of Arts, Manufactures, and Commerce" should take into consideration the state of book illustration in the present day. The words which head the proceedings of this Society are singularly applicable; the "Art, Manufacture, and Commerce" of a book is well worth examining.

The modern publisher, it may be said without offence, understands the manufacture and the commerce of a book, better than the art in it. And how should it be otherwise? The best books that were ever produced, from an artistic point of view, were inspired and designed by students of art and letters, men removed from the commercial scramble of life, and to whom an advertisement was a thing unknown! The ordinary education of a publisher, and the multitude of affairs requiring his attention, unfit him for the task of deciding whether an illustration is good or bad; or how far—when he cheapens the production of his book by using photographic illustrations ("snap shots" from Nature)—he is justified in calling it "art."

It would be difficult, I think, to point to a

period when so much bad work was produced as at present. The causes are not far to seek. As matters stand at present, the beautiful processes for the reproduction of drawings for the type press are scarcely understood by the majority of artists, publishers, authors, or critics. It is the misuse of these processes which is dragging our national reputation in the mire. Our best artists have neither the time nor the inclination to make themselves acquainted with the methods, and it is hardly to be expected that a reviewer who has a pile of illustrated books to pronounce upon should know the reason of the failures that he sees before him. Thus the public is grievously misled by those who should be its guides as to the value and importance of the new systems of illustration.*

The deterioration in the character of book illustration in England is a serious matter, and public attention may well be drawn to it. The first and most serious difficulty to contend against is the comparatively low estimate of this class of work, and the competition of photographs. The second is the want of good technical education in this direction. Students leave art schools by hundreds not properly equipped for the business of life. The business of many will be to contribute, in some form, to the making of pictures and designs to be multiplied in the press; and, in order to learn the technique and obtain employment, some of the most promising pupils have to fall into the ways of the producers of cheap illustrations, Christmas cards, and the like. On the other hand, a knowledge of the mechanical processes for reproducing drawings (as it is being pressed forward in technical schools) is leading to disastrous consequences, as may be seen on every railway bookstall in the kingdom.

It is the special purpose of these lectures to inquire into the conditions under which process illustrations (to use the common phrase) are now produced, and to see how far, and in what way, we may obtain the best results.

It cannot have escaped observation that in the various lectures, demonstrations, and discussions held under the auspices of the Society of Arts, on the subject of book illustration, little has been said about the illustrator, upon

* There seems but one rule of criticism in this connection. If a book illustration comes out coarsely and (as is often the case) a mere smudge, the process is blamed, when the drawing or photograph may have been quite unsuitable for the process employed.

whom so much in the future will depend. In May, 1882, Mr. J. Comyns Carr gave three Cantor lectures on "Book Illustration" (old and new) in which the subject was treated historically, and in which the wood engraver's art was most considered. In 1878, and in 1884, Mr. Thomas Bolas gave several Cantor lectures with practical demonstrations; in 1878, on "The Application of Photography to Printing Surfaces," and in 1884, on "Improvements in Photo-Mechanical Printing Processes." And during the last ten years several excellent papers have been read on Wednesdays on artistic and decorative illustration, notably by Mr. Walter Crane and Mr. L. F. Day; also one in 1891, when the whole *modus operandi* of the production of a daily illustrated newspaper was made plain before you by Mr. Carmichael Thomas, of the *Graphic*.

All these papers, valuable as they are for reference and help, leave, I think, much to be said as to the illustrations of to-day from the artists', the authors', and the publishers' point of view.

First. As to line drawing for reproduction by the type press. It cannot be sufficiently borne in mind—I am speaking now to students who are not intimate with the subject—that to produce with pure black lines the quality and effect of lines in which there is some gradation of tone, is no easy matter, especially to those accustomed to the wood engraver as the interpreter of their work. Sir John Tenniel, Mr. du Maurier, and Mr. Sambourne, not to mention others on the *Punch* staff, have been accustomed for many years to draw for wood engraving and would probably still prefer this method to any other.

But the young illustrator has to learn the newer methods, and how to get his effects through direct photo-engraving. What may be done by the latter is sufficiently demonstrated in the line drawings which appear in our newspapers, magazines, and books; I speak of those which are well printed and on good paper. Many German and French periodicals teach us what to admire and what to avoid. I am referring only to line drawing in this first lecture, because it is the only process in relief which may be said to give any certain results, leaving the consideration of other developments of process work until next week. Line drawings are now reproduced on zinc blocks fitted for the type press at a cost of less than sixpence the square inch for large blocks. The first condition for this process is to draw in pure black

lines on Bristol board, or smooth white paper; the process of reproduction will be explained further on.

Let us glance first at the ordinary hand-book teaching, and see how far it is useful to the illustrator of to-day. The rules laid down as to the methods of line work, the direction of lines for the expression of certain textures, "cross-hatching," &c., are, if followed too closely, apt to lead to hardness and mannerism in the young artist, which he will with difficulty shake off. On these points, Mr. Robertson*, the well known painter and etcher, writing seven years ago, says well:—

"The mental properties of every line drawn with pen and ink should be original and personal . . . this strong point is sure to be attained unconsciously, if an artist's work is simple and sincere, and *not the imitation of another man's style.*"

"When the question arises as to what examples a beginner should copy who wishes to practise the art of pen-and-ink drawing, the difficulty will be to select from the great and varied stores of material that are everywhere to his hand. All steel and copper-plate engravings that have been executed in line, and all wood engravings, are within the possible range of pen-and-ink drawing. I hold, however, that much time should not be occupied in the imitative copying of prints: only, indeed, so much as enables the student to learn with what arrangement of lines the different textures and qualities of objects may be best rendered."

There are, roughly, two methods of obtaining effect with a pen—one by few lines, laid slowly; and the other by many lines, drawn with rapidity. If the intention is to see what effect may be obtained with comparatively few lines deliberately drawn, we may refer to the woodcuts after Albert Dürer and Holbein, and the line engraving of Marc Antonio. The engraved plates by Dürer furnish excellent examples of work, with more and finer lines than his woodcuts. "Some of the etchings of Rembrandt are examples of what may be fairly reproduced in pen and ink, but in them we find the effect to depend upon innumerable lines in all directions. In the matter of landscape the etched plates by Claude and Ruysdael are good examples for study, and in animal life we may refer to those of Paul Potter and Dujardin."

* "The Art of Pen and Ink Drawing," by H. R. Robertson. London: Winsor and Newton, 1886.

Thus, for style, for mastery of effect and management of line, we must go back to the old masters, to work produced generally in a reposeful life, to which the younger generation are strangers. But the mere copying of other men's lines is of little avail without mastering the principles of the art of line drawing. The skilful copies, the *fac-similes* of engravings and etchings drawn in pen and ink, which are the admiration of the young artist's friends, are of little or no value in deciding the aptitude of the student. The following words are worth placing on the walls of every art school:—"Proficiency in copying engravings in *fac-simile*, far from suggesting promise of distinction in the profession of art, plainly marks a tendency to *mechanical pursuits*, and is not likely to be acquired by anyone with much instinctive feeling for the arts of design."

There is much truth and insight in this remark.

In line work, as now understood, we are going back, in a measure, to the point of view of the missal writer and the illuminator, who, with no thought of the possibilities of reproduction, produced many of his decorative pages by management of line alone (I am speaking of the parts of his work in which colour was not employed). No amount of patience, thought, and labour was spared for this one copy. What would he have said if told that in centuries to come this line work would be revived in its integrity, with the possibility of the artist's own lines being reproduced 100,000 times, at the rate of several thousand an hour. And what would he have thought if told that out of thousands of students in centuries to come, a few, a very few only, could produce a decorative page; and that few could be brought to realise that a work which was to be repeated, say a thousand times, was worthy as much attention as his ancestors gave to a single copy!

On the principle that "everything worth doing is worth doing well," and on the assumption that the processes in common use—I purposely omit mention of the olden systems of drawing on transfer paper, and drawing on waxed plates, without the aid of photography; also of photo-lithography; these have been dealt with in previous papers—are worth all the care and artistic knowledge which can be bestowed upon them, we would press, upon young artists especially, the importance of study and experiment in this direction. As there is no question that "the handwork of the artist" can be seen more clearly through

mechanical engraving than through wood engraving, it behoves him to do his best. And as we are substituting process blocks for wood engraving in every direction, so we should take over some of the patience and care which were formerly given to book illustrations.

We cannot live, easily, in the cloistered silence of the past, but we can emulate the deliberate and thoughtful work of Mantegna, of Holbein, of Albert Dürer, and the great men of the past, who, if they were alive to-day would undoubtedly have preferred drawing for process to the labour of etching and engraving; and, if their work was to be reproduced by others, they would have perceived, what it does not require much insight in us to realise, that the individuality of the artist is better preserved, by making his own lines than by those of the engraver. To do this successfully in these days, the artist must give his best and most deliberate (instead of his hurried and careless) drawings to the processes; founding his style, to a limited extent, it may be on the work of the old engravers, but preserving his own individuality.

But we must not slavishly copy sketches by the old masters, which were never intended for reproduction. We may learn from the study of them the power of line to express character, action, and effect, we may learn composition sometimes, but not often, in a sketch.

As to copying the work of living artists, it should be remembered that the manner and the method of a line drawing is each artist's property, and the repetition of it by others is injurious to him. It would be an easy method indeed if the young artist, fresh from the schools, could, in a few weeks, imitate the mannerism, say of Sir John Gilbert, whose style is founded upon the labour of 50 years. There is no such royal road.

But for the illustrator by profession there seems no artistic leisure in 1893, no time to do anything properly in this connection.

"It is a poor career, Blackburn," said a well-known newspaper illustrator to me lately (an artist of distinction and success in his profession who has practised it for 20 years), "you seldom give satisfaction—not even to yourself."

"It is an *ideal career*," says another, a younger man, who is content with the more slap-dash methods in vogue to-day, and with the income he receives for them.

There is another point to notice. The education of the illustrator in these days means much more than mere art training. The

tendency of editors of magazines and newspapers is to employ those who can write as well as draw. This may not be a very hopeful sign from an art point of view, but it is a condition of things which we have to face.

In sketches of society the education and standing of the artist has much to do with his success. Mr. du Maurier's work in *Punch* may be taken as an example of what I mean, combining excellent art with knowledge of society. His clever followers and imitators lack something which cannot be learned in an art school.

Much as we may desire to see a good artist and a good *raconteur* in one man, the combination will always be rare; and those editors who seek for it are often tempted to accept inferior art for the sake of the story. I mention this as one of the influences affecting the quality of illustrations of an ephemeral or topical kind, which should not be overlooked.

It should be borne in mind that, in drawing for reproduction by any of the mechanical processes (either in wash or in line, but especially the latter), there is more strain on the artist than when his work was engraved on wood, and the knowledge of this has left process drawing principally in the hands of the younger men. They will be older by the end of the century, but not as old then as some of our best and experienced illustrators who keep to wood engraving.

I am touching now upon a difficult and delicate part of the subject, and must endeavour to make my meaning clear. The illustrations in *Punch* have, until lately, all been engraved on wood (the elder artists on the staff not taking kindly to the processes), and the style and manner of line we see in its pages is due in great measure to the influence of the wood engraver.*

This refers to *fac-simile* work, but the engraver, as we know, also interprets wash into clean lines, helps out the timid and often unsteady draughtsman, and in little matters puts his drawing right.

Now the wood engraver was apprenticed to his art, and after long and laborious teaching, mastered the mechanical difficulties. If he had the artistic sense he soon developed into a master-engraver and illustrator, and from crude

and often weak and inartistic drawings he produced illustrations full of tone, quality and beauty. (He does so still, to a limited extent, as many an author knows.)

From very slight material handed to him from a publisher the wood engraver would evolve (from his inner consciousness so to speak) an elaborate and graceful series of illustrations, drawn on the wood block by artists in his own employ, who had special training, and knew exactly how to produce the effects required. The system often involved much care and research for details of costume, architecture and the like, and, if not very high art, was at least well paid for, and appreciated by the public. I am speaking of the average illustrated book, say of twenty years ago, when it was not an uncommon thing to spend £500 or £600 on the engravings of a book. Let us hope that the highest kind of wood engraving will always find a home in England.

I do not think the modern illustrator realises how much depends upon him in taking the place, so to speak, of the wood engraver. But the interpreting of tone into line fitted for the type press, to which the wood engraver gave a lifetime, will devolve more and more upon him. We cannot keep this too continually in mind, for, in spite of the limitations in mechanically-produced blocks (as compared with wood engraving) in obtaining delicate effects of tone in line, much can be done in this direction, in which the engraver has no part. That it is possible, by the common processes, to obtain effects almost equal to wood engraving, may be seen in the illustrations to Mr. Andrew Lang's "Blue Poetry Book," by Mr. Lancelot Speed, in which many technical experiments have been made, including the free use of white lining by process.* But more notably, from an art point of view, are the illustrations, produced lately at the Birmingham Municipal School of Art, by process-drawing, one of which I will show you on the screen.

All this, you will observe, points to a higher use of the process block than is generally allowed, to something, in short, very different to the thin sketchy outlines and scribbles which are considered the proper functions of the "pen and ink artist."

But "the values" are scarcely ever con-

* One of the most accomplished of English painters told me the other day that when he first drew for illustration, the wood engraver dictated the angle and style of cross-hatching, &c., so as to fit the engravers' tools.

* Mr. Robertson's hand-book is here a little out of date, where he says:—"Woodcuts in which white lines play a prominent part are obviously unsuited as examples or suggestions for pen and ink work"; but white lines, drawn with pen or brush, are continually used in process work.

sidered in this connection. Mr. Hamerton makes a curious error in his "Graphic Arts," where he advocates the use of the "black blot in pen drawing," arguing that as we use liberally white paper to express air and various degrees of light, so we may use masses of solid black to represent many gradations of darkness. A little reflection will convince any one that this is no argument at all.

The ideal illustration by mechanical means is, where the principles of line engraving are followed to the utmost limits of pen-and-ink drawing, where the lines of the drawing do not intrude upon the effect—a drawing which can be reproduced with the least touching or "rouletting" on the block, and which requires the least "overlying" and "making ready" on the part of the printer.

Mr. Ruskin's advice, in his "Elements of Drawing," as to how to lay flat tints by means of pure black lines (although written many years ago, and before mechanical processes of reproduction were in vogue) is singularly applicable and useful to the student of to-day, especially where he reminds him that, "if you cannot gradate well with pure black lines, you will never do so with pale ones."

To "gradate well with pure black lines" is, so to speak, the whole art and mystery of drawing for the photo-zinc process, of which one London firm alone turns out more than a thousand blocks a week.

As to the amount of reduction that a drawing will bear with advantage in reproduction it cannot be sufficiently widely known, that in spite of rules laid down, there is no rule about it.

Mr. Emery Walker, of the firm of Walker and Boutall, who has had great experience in the reproduction of illustrations and designs from the old books and manuscripts, will tell you that very often there is no reduction of the original; and he will show reproductions in photo-relief of engravings and drawings of the same size as the originals, the character of the paper, and the colour of the printing also, so closely imitated, that experts can hardly distinguish one from the other.

On the other hand the value of reduction, for certain styles of drawing especially, can hardly be over estimated. On these walls next Monday you may see drawings reduced to one-sixteenth the area of the original, some even more, and results obtained which could be achieved by no other means.

Again I say "there is no rule about it."

In the course of years, and in the reduction to various scales of thousands of drawings by different artists, to print at the type press, my experience is that *every drawing has its scale, to which it is best reduced.*

A word as to sketching in line from life ready for reproduction on a process block. The system is, I know, followed by a few illustrators for newspapers (whose names might easily be mentioned), who, by incessant practice, have become proficient. They have special ability for this kind of work, and their manner and style is their capital and attraction.

But to attempt to teach rapid sketching in pen and ink is beginning at the wrong end, and is fatal to good art; it is like teaching the principles of pyrotechnics whilst fireworks are going off. And yet we hear of prizes given for rapid sketches to be reproduced by the processes. Indeed, I believe that is the wrong road; the baneful result of living in high-pressure times. Imagine any artist of the past—you might almost say any artist of the present—consenting to such a system of education.*

Sketching from life is, of course, necessary to the student, but it should be done in pencil or whatever medium is easiest at the moment; but the lines for reproduction require thinking about, thinking what to leave out and how to interpret the grey of a pencil, or the tints of a brush sketch in the fewest lines. Thus, and thus only, the student learns the art of leaving out, "the value of a line."

The tendency of modern illustrators is to imitate somebody; and in line drawing for the processes, where the artist, and not the engraver, has to make the lines imitation of some man's method, is almost inevitable.

Let me quote an instance. The style of the late Charles Keene is imitated in more than one journal at the present time, the artists catching his method of line more easily than the higher qualities of his art, his *chiaroscuro*, his sense of values and atmospheric effect. I say nothing of his pictorial sense and humour, for they are beyond imitation. It is the husk only we have presented to us.

As a matter of education and outlook for the younger generation of illustrators, this imitation of other men's lines deserves our special consideration. Nothing is easier in line work than to copy from the daily press.

* Mr. Joseph Pennell's wonderful pen and ink drawings from the towers of Notre Dame are the exception which prove the rule.

Nothing is more prejudicial to good art, or more fatal to progress.

And yet it is the habit of some instructors to hold up the methods (and the tricks) of one draughtsman to the admiration of students. In that most artistic and informing publication, *The Studio*, the newest and most welcome of our art publications, I was amazed to read the other day a suggestion for the better understanding of the way to draw topical illustrations in pen and ink. It was suggested that examples of the work of Vierge, Rico, Abbey, Raven Hill, and other noted pen draughtsmen, should be set as an exercise to students!

I venture to say from long experience, that this is not the right road. Of all branches of art none leads so quickly to mannerism as line work, and a particular manner when thus acquired is difficult to shake off.

Think of the consequences—Vierge with his garish lights, his trick of black spots, his neglect of *chiaroscuro*—all redeemed and tolerated in a genius for the dash and spirit and beauty of his lines, lines, be it observed, that seldom reproduce well on relief blocks—imitated by countless students, Mr. E. A. Abbey, the refined, and delicate American draughtsman, imitated for his method—the style and *chic* of it being his own, and inimitable. Think of the crowd coming on—imitators of the imitators of Rico—imitators of the imitators of Charles Keene!

Having now demonstrated, I hope satisfactorily, that pure line drawing is the basis of the best drawing for the press, let us examine a few examples, and see what harmonies and discords may be played on this instrument with one string.

One string—no “messaging about,” if you will excuse the phrase, pure black lines on Bristol board, photographed on to a zinc plate, the white parts etched away and the drawing made to stand in relief, ready to print with the letterpress of a book; every line and touch coming out a black one, or rejected altogether by the process.

[Mr. Blackburn then exhibited on the screen on a large scale a series of line drawings by different artists, each showing a different method of expression in line. Nearly all were excellent for reproduction by the zinc, or gelatine, relief processes; many of them suggesting colour, atmosphere, tones and values, the treatment of backgrounds, &c., and generally, a freedom and variety of handling by the line processes.]

Miscellaneous.

RUSTLESS COATING FOR IRON.

The following is a translation by Mr. Frederic W. North of a paper read before the Paris Société d'Encouragement by M. Octave de Rochefort-Lucay, on the new Bertrand processes for coating with magnetic oxide and enamelling iron and iron carburets, and on a new process of tinning for cast iron.

Messrs. Barff and Bower were the first to practically coat iron, steel, and cast iron with magnetic oxide, so as to form, at the cost of the metal itself, the protective layer that is obtained usually from paint, or from enamelling, &c., with a thin coating of a metal that is not oxidisable.

The Bertrand processes are more simple than those of Bower and Barff, and are based on a new discovery in chemistry, and may be stated thus:—If a thin adherent film of another metal is formed on the wrought iron or on the cast iron, and this iron or cast iron, heated to 1000°, is exposed to a current of oxidising gas, the oxygen penetrates through the film, oxidises the iron or the cast iron, and under these conditions, magnetic oxide is the result. The formation of magnetic oxide, thus obtained, continues indefinitely, and the thickness of the coating of oxide increases according to the period of exposure to the oxidising current, providing the temperature remains at about 1000°.

As to the film of metal deposited in the first instance, it disappears in some obscure way, forming oxides which mingle with the magnetic oxide or volatilize according to the nature of the metal of which they are composed. M. Bertrand had then to find the best metal and the best method for depositing it on the article to be coated, and he has found that bronze, a mixture of copper and tin, gives from a practical point of view every satisfaction. For depositing this bronze on the wrought iron and cast iron, M. Bertrand uses electricity or wet baths, and uses sulphophenolic acid.

The following is the method adopted in the Bertrand manufactory for an oxidation:—The article is cleansed (the cleansing is not indispensable), then dipped a few moments in a bath containing a solution of sulphophenate of copper and tin. The coating of bronze being formed, the article is immediately washed with cold water and dried with sawdust. The article dried is put into a furnace. Oxide forms, and at the end of fifteen to thirty minutes (according to the articles) the article is taken out, sufficiently oxidised. The coating produced varies from $\frac{1}{10}$ th to $\frac{1}{4}$ th of a millimetre.

M. Bertrand uses electricity to ascertain if the coating is of sufficient and uniform thickness, and in doing so he makes use of bells. If in putting the two wires in contact with the oxidised article the bells ring, the current passes—the oxidation is insufficient; if it remains silent, the oxide formed is of sufficient

practical thickness because it prevents the electric current from passing.

Process for Tinning Cast Iron.—M. Bertrand has also used sulphophenolic acid to obtain tinning on iron. He dissolves salts of tin in a mixture of water and sulphophenolic acid at the rate of 1 per cent. of tin salt, and 5 per cent. of sulphophenolic acid. In this mixture the article, which is previously cleaned, is dipped; and is at once covered with an adherent coating of tin, and afterwards by the means of rotating brushes in wire and cloth, the coating of tin is polished, and a result obtained which is both effective and cheap.

Process for Enamelling.—There are not more than two processes for enamelling cast iron. In the first, called hot, the iron, heated to a vivid red, is powdered with a flux powder (borosilicate of lead), distributed with a sieve, then it is heated, and when the flux fuses, it is powdered afresh with glass more soluble, forming the glaze of the enamel. This process, the only direct enamelling, is dangerous to the operator, and even impossible for large articles, nor does it allow of decorations. The second process consists of dressing the cast iron either by three distinct and successive operations in the furnace with a kind of pottery. In the Bertrand enamelling, the article is first coated with magnetic oxide, then dipped in borosilicates of lead, coloured by metallic oxides, in which is added a little pipe-clay in order to give rather more body. The article thus covered cold, by dipping or with brushes, is put into the furnace; the enamel adheres and vitrifies at the usual furnace temperatures used by enamellers. By putting a coating of coloured enamel with a brush on a first coat simply plain, it is possible to make any decorations desired, which may be burnt in at one operation for outdoor vases, &c. These results, due to the first oxidation with magnetic oxide, are remarkable, as much for the colour as for the tenacity of the enamel and its resistance to rough usage.

TECHNICAL EDUCATION BOARD OF THE LONDON COUNTY COUNCIL.

The Technical Education Board will in January next proceed to award not more than 10 free scholarships at the Training School for Teachers of Domestic Economy, at the Battersea Polytechnic, under the following conditions:—

1. Candidates must be not less than 20 nor more than 30 years of age; they must be resident within the Administrative County of London, and must continue to reside therein during the tenure of their scholarships.

2. Candidates must undertake to attend the school regularly, at such times as may be appointed by the governing body, during the space of one year.

3. Candidates must possess a good general education, and must prove the same to the satisfaction of the Board, and they must be able to speak distinctly;

they must be provided with a medical certificate of health, and with a testimonial of good character from not less than two responsible persons.

4. The names of candidates must be sent to the Secretary of the Board not later than January 9th, 1894, on forms which will be obtainable on application at the Board's offices on and after January 1st, 1894. The Board will require evidence that the candidates are not in a position to provide their own training without such aid as the scholarships are intended to afford.

5. The Board reserves the right at any time to determine any scholarship without notice, upon being satisfied that its continuance is, for any reason, undesirable, and on all questions connected with the award or tenure of the scholarships, the decision of the Board shall be final.

6. The school at which the scholarships will be tenable will be the Training School of Domestic Economy at Battersea Polytechnic.

7. The students selected will receive a thorough training in the teaching of cookery, laundry, needlework, dressmaking, and housewifery; and will also receive instruction in hygiene, sick nursing, and "first aid." All materials required will be supplied by the Polytechnic, and the students will be provided with two meals a day free of expense, and will retain possession of the garments made by them in the course of their instruction.

8. The selection of candidates will be made by the Board; preference will be given to those candidates who have had previous experience in (a) teaching, (b) the practice of any of the subjects of instruction, (c) practical work amongst the poor of London which has given them a knowledge of the lives and homes of the working classes.

9. The Board does not undertake to employ the students, or any of them, on the expiration of their training. They will be free to accept any appointment that may be offered to them, whether in London or elsewhere.

TECHNICAL EDUCATION FOR PAINTERS.

A Committee of the National Conference of Painters and Decorators has been appointed to consider the best means (if any) for giving effect to the resolutions of the Conference:—(1) As to a new organisation of a representative character, and with authority and prestige sufficient to give to its mandates weight and respect in the country, dealing with—(a) Technical education for painters; (b) registration for painters. The Consultative Committee thus appointed have met, and, after consideration, have laid down the lines upon which, in their opinion, such an organisation might be built, and have indicated the general scope of its operations.

The Committee are anxious, however, to see how far the proposed scheme is likely to gain the sympathetic concurrence of the trade, and to that end they submit for consideration and reply the following

questions, and they earnestly ask for co-operation in coming to a right solution of the questions:—(1.) Is there a masters' organisation in the town? (2.) Is there an organisation amongst the men? (3.) Have you any technical or educational institute in connection with which the scheme could be worked? (4.) Failing this would the employers of the town, in conjunction with the men, organise a class, and try and promote the object we have in view? (5.) If you have an organisation, would you kindly ascertain the opinion of the members on the above subjects, and furnish the committee with the result as soon as possible? (6.) In the absence of any society would you consult with other employers and leading workmen, to endeavour to arrive at a decision. Replies should be addressed to the Chairman of Technical Education Committee, Painters'-hall, London, E.C.

ATTENDANCE AT THE WORLD'S FAIR.

An American report upon the Chicago Exhibition states that the period during which the Exhibition was open extended over 183 days, of which 179 were open days, the exception being the four Sundays (May 7th, 14th, and 21st, and July 23rd) when the gates were closed to the public, and open only to those whose passes denoted that they had business in the grounds. Of the 183 days, 27 fell on Monday, for Monday opened and closed the Fair, while each of the other days numbered 26. Thursday was the popular day, although Monday and Saturday nearly equalled it. The daily attendance reports show that 3,621,358 people paid for admission on 27 Mondays, or an average of 134,124; the 26 Tuesdays were chosen by 3,395,308 people, or an average of 130,588; the 26 Wednesdays by 3,208,310, or an average of 123,396; the 26 Thursdays by 3,581,047, or an average of 137,732; the 26 Fridays by 2,875,379, or an average of 110,591; the 26 Saturdays by 3,576,975, or an average of 137,565; and the 22 open Sundays by 1,216,867, or an average of 55,312. The total Sunday attendance did not equal any of the last three weeks' attendance, and the average Sunday attendance was slightly more than one-half Friday's average, the poorest show-day of the week. The smallest attendance was on Friday, May 5th, when 10,791 persons paid to pass through the gates. There were 92 days when the attendance rose above 100,000, 53 days when it passed 150,000, 25 days when it exceeded 200,000, 11 days when it was over 250,000, four days when it was over 300,000, and one day when it exceeded 700,000. The attendance by months did not vary except by moving forward and upward in an accelerated degree. The attendance in May was 1,050,037; June, 2,675,113; July, 2,760,263; August, 3,515,493; September, 4,659,871; October, 6,816,435; total, 21,477,212, of whom 1,253,938 were children. The total attendance, including passes, was 27,529,400.

Correspondence.

CARRIAGEWAY PAVEMENTS FOR LARGE CITIES.

Mr. HENRY FAIJA, M.I.C.E., writes:—As Mr. Isaacs says, there is no doubt that the foundation is the roadway, the covering on which the traffic rolls being simply a medium to facilitate the traffic, and, in a manner, to protect the foundation or roadway proper—such being the case, it is important that the foundation should be of considerable strength, and practically permanent, and economy I take it is a matter for consideration, in conjunction, of course, with strength and permanency. Now a Portland cement, concrete-gauged in the proportion of six of ballast to one of cement, is stronger, more durable, and in every way better qualified to resist the concussion of traffic than a blue lias lime, concrete-gauged in the proportion of three parts of ballast to one of blue lias lime, and if the prices of these materials are considered, it will be seen that the Portland cement concrete is the cheaper. The approximate cost of these materials delivered on to the roadway, at the present time, may be taken to be—Portland cement, 25s. per ton, blue lias lime 13s., and Thames ballast, 1s. 6d.; and gauged in the proportions mentioned, the Portland cement concrete would come out at 5s. 4d. per cubic yard, and the blue lias lime concrete at 5s. 10d. per cubic yard—for materials only. Portland cement concrete, again, has the advantage that it attains a hardness and strength capable of resisting the weight and concussion of the traffic, at a much earlier date than a concrete compound of blue lias lime, and this is a matter of considerable importance to municipal engineers and surveyors, as the annoyance and worry of having roadways up for a lengthened period is considerably reduced. With respect to the tests for cement mentioned in Mr. Isaacs's paper, I cannot altogether agree. I have tested and reported on the cement used in the roadways for most of the London Vestries, and my experience is that the only tests required are those for tensile strength, time of set, fineness and soundness, or freedom from expansion in construction. I will not go into the details of these tests, as my views on this matter have been fully expressed in the several papers which I have read on the subject, but I would particularly refer to the paper which I communicated to the International Congress at Chicago, a copy of which I had the honour of forwarding to you for your library. I should like to say one word respecting blue lias lime, as Mr. Isaacs seems to think that it has a bad habit of "blowing." Well, all limes will "blow" if they are not properly hydrated or slacked before use. Blue lias lime, as used for concrete, is hydrated by being ground, thus allowing it to be attacked in detail by the moisture and carbonic acid in the atmosphere, and if it is used too soon after grinding it will, no doubt, in many instances "blow, and the

only way to correct this tendency is to use an abundance of water for gauging, and to turn it over and work it thoroughly before allowing it to rest.

Mr. GEORGE N. HOOPER writes:—As the civil engineers and road surveyors improved the road surfaces and gradients, so the conveyance of passengers and goods by carriages or wagons displaced the saddle or pack horse; as they were further improved, so higher and better carriages were invented or provided. A few years ago, very high American wheels were common on Broughams and Victorias in the streets of London, but when iron channel tram-rails were laid down, these very light wheels became dangerous; they dropped into the iron channels, and if they could not roll out, were torn out by main force and destroyed. Roads with good surfaces were indispensable for the heavily top-loaded mail and stage coaches of two generations ago, as they are now for the top-loaded omnibuses that now run on the London streets. Moreover, the road surfaces had a further influence on the vehicles. Do you suppose that the Hansom cabs of to-day, with their high American wheels and india-rubber tyres, would be possible, unless the road surfaces were far better than formerly, or that the fairy-like vehicles, the bicycles, could exist on bad road surfaces? The tram-rails have a very detrimental effect on light carriages when crossing them, and the under-works of such have now to be made stronger to resist the shocks they constantly encounter. Further, they have the effect of producing a rough burr on the edge of iron tyres, and a still sharper and cutting burr is raised on steel tyres. The time is rapidly approaching when pneumatic tyres will be used on road-carriages. Many inventive and practical minds are at work to prevent puncture by sharp stones, and when the road-makers expel these, a further step in advance will be taken; noise will be reduced and comfort promoted. An absolute revolution is necessary as regards street surface cleansing from many points of view, especially sanitary. The dust and mud is no longer diluted with granite or flint powder, they are now almost pure pounded horse-droppings. I know of one case where a gentleman suffering from weak eyes had to give up driving, as the London street dust was, in his case, of so irritant a character. The surfaces should be thoroughly washed during the night; it would probably be better to use mechanical scrapers and brushes for efficiency and rapidity. The recent dry spring and summer have probably had a pernicious effect on the road surfaces and the health of Londoners, for the filth accumulated was rolled down, caked on the surfaces, and when rain came there was an excess of mud of a very concentrated kind. The more quickly such is removed the better will it be for all within its influences. In relation to the durability of street surfaces, their efficiency, and their cost, the amount and kind of

traffic on roads and streets depends greatly on the policy of the local authorities. Certain well known establishments, that fulfil national wants, promote and necessitate traffic, such as railway stations, harbours, docks, markets, banks, government and municipal offices, palaces of the king or queen, theatres, &c.; but where concentration of traffic is not essential to the public welfare, it should be distributed, letting each road or street bear its fair share of traffic, not only for the sake of economy of maintenance, but for the safety of persons in carriages and on foot. Great cities are now places of great danger to life and limb—to the aged, the weak, the nervous, the deaf, the children, and those whose sight is imperfect. The regulation of the traffic by the police is an excellent step in advance, so are the street-refuges and the better lighting at night. But a great effort should be made to distribute traffic more equally over many streets, instead of allowing it to become congested where it is now excessive, dangerous, and costly, by reason of undue wear and tear.

Notes on Books.

LONGMAN'S ADVANCED SCIENCE MANUALS.—
I. "Building Construction." By the author of "Notes on Building Construction." II. "Magnetism and Electricity." By Arthur William Poyser, M.A. London: Longmans, Green, and Co.

The former volume is recommended by the author to students as containing all the information required for the South Kensington Examination in the Second Stage or Advanced Course of Building Construction, and is divided into thirteen chapters, dealing respectively with stresses on structures, materials, excavations, shoring, scaffolding, pile foundations, brickwork and masonry, timber roofs, roof coverings, joinery, stairs, riveting, wrought-iron girders, fireproof floors, iron roofs, and plasterer's work. The figured examples, of which there are about 400, add to the utility of the work, which also includes the examination papers set in the years 1888-89-90-91 by the Science and Art Department. Mr. Poyser's book, which is also copiously illustrated, is intended not only for South Kensington, but for anyone who is desirous of obtaining a practical knowledge of the facts and laws of the science of magnetism and electricity. Altogether, there are scattered throughout the volume upwards of three hundred and seventeen useful illustrations, mainly engraved from the author's own drawings. A succinct account of some of the practical applications of electricity is presented, and, as Mr. Poyser explains, in order to give the reader an idea of the direction of modern thought in this branch of science, one of the chapters is devoted to recent researches. The first part of this comprehensive work deals with

Magnetism, the second with Frictional Electricity, and the third with Voltaic Electricity. Another feature of the manual is the reproduction of the following examination papers:—South Kensington, Advanced Stage (1892); Intermediary B.Sc., London University, 1891; Preliminary, M.B., London University, 1891; Matriculation, London University, June, 1892; Cambridge Local (Senior), 1891; Oxford Local (Junior), 1892; Oxford Local (Senior), 1892; College of Preceptors, 1892.

TWENTY-FIVE YEARS' PRACTICAL EXPERIENCE OF NATURAL ASPHALT AND MINERAL BITUMEN. By W. H. Delano. London (Spon), 1893. Sm. 8vo.

In a small pamphlet of 73 pages the author has given a large amount of information of a practical character on the uses of asphalt and the modes of applying it, and his remarks are illustrated by a large number of figures. The author gives a list of asphalt mines, and affirms that the produce of the island of Trinidad is a mineral bitumen, and not a natural asphalt. The following figures as to the relative traffic on asphalt streets in Paris and London are curious:—

PARIS.

Number of vehicles passing
in the 24 hours.

Rue de Rivoli	42,935
Rue Croix des Petits Champs. .	20,480
Rue St. Honoré	19,672
Rue Auber	14,082
Avenue de la Grande Armée..	8,149

LONDON.

King William-street	26,793
Queen Victoria-street	16,531
Gracechurch-street	15,585
Cheapside	15,206
Aldgate.....	14,200
Newgate-street	13,128
Holborn-viaduct	12,158
Moorgate-street	11,398
Cornhill	9,572

L'ASPHALTE: son origine, sa préparation, ses applications. Deuxième édition entièrement refondue et mise au courant des dernières perfectionnements de l'Industrie de l'Asphalte. Par Léon Malo. Paris: 1888. Sm. 8vo.

This little volume is the second edition of a work first published in 1866, and contains a full account of the asphalt industry, and an appendix of documents respecting the use of asphalt in Paris and London.

TRANSACTIONS AND PROCEEDINGS OF THE JAPAN SOCIETY, LONDON. Vol. I. London: 1893. Royal 8vo.

This society was founded at the beginning of the year 1892, with the object of encouraging "the study of the Japanese language, literature, history, and folk-lore, of Japanese art, science, and industries, of the social life and economic condition of the Japanese

people, past and present, and of all Japanese matters." This large and handsome volume contains the "Transactions" of the society during its first session; and the interesting papers which are printed are fully illustrated by engravings. The first paper is on "The Ancient Art of Self-Defence by Sleight of Body," by T. Shidachi, and this is illustrated by four plates. The next paper is on "The Uses of Bamboo in Japan," by Mr. Charles Holme; the third, on "Some Japanese Art-workers (crape printers)," by Mrs. Ernest Hart; nine plates are apportioned to this paper. Mr. W. Gowland contributed a paper on "The Naturalistic Art of Japan," and 124 Kakemono, from Mr. Gowland's collection, were exhibited at the meeting when this was read. A paper, by Mr. E. Gilbertson, on the "Genealogy of the Miochin Family, Armourers, Swordsmiths, and Artists in Iron, from the Twelfth to the Eighteenth Century," is illustrated by 13 plates. The earlier meetings of the Japan Society were held in the rooms of the Society of Arts, but the society has now a home of its own in Hanover-square, and on December 31st, 1892, there was on the roll a total number of 365 members.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

JANUARY 17.—"White Lead Substitutes." By A. LAURIE, M.A.

JANUARY 24.—"American Carriages." By G. HERBERT THRUPP.

JANUARY 31.—"Californian Wines." By CHARLES P. OLDHAM.

FEBRUARY 7.—"Reproduction of Colours by Photography." By CAPTAIN W. DE W. ABNEY, C.B., F.R.S.

FEBRUARY 14.—"The St. Pancras Electric Light Installation." By HENRY ROBINSON, M.Inst.C.E.

FEBRUARY 21.—"Electric Signalling without Wires." By WM. HENRY PREECE, F.R.S.

Papers for which dates have not yet been fixed:—

"London Coal Gas and its Enrichment." By PROF. VIVIAN LEWES.

"Automatic Balance of Reciprocating Machinery, and the Prevention of Vibration." By W. WORBY BEAUMONT.

"Experiments in Aeronautics." By HIRAM S. MAXIM.

"Automatic Gem and Gold Separator." By WILLIAM S. LOCKHART.

"Application of Electricity to the Disinfection of Sewage." By MONS. HERMITE.

"Rainfall Records in the British Isles." By G. I. SYMONS, F.R.S.

INDIAN SECTION.

The meetings of this Section will take place on the following Thursday Afternoons, at Half-past Four o'clock :—

JANUARY 18.—“The Petroleum Fields of India: their Present Condition and their Probable Future.” By R. D. OLDHAM, A.R.S.M., Superintendent Geological Survey of India. SIR EDWARD CHARLES BERNARD, K.C.S.I., will preside.

FEBRUARY 15.—“Experiences at the Court of Afghanistan.” By JOHN A. GRAY, late Surgeon to His Highness Ameer Abdur Rahman.

MARCH 8.—“The Indian Currency.” By J. BARR ROBERTSON.

MARCH 15.—“Indian Railway Extension: its Relation to the Trade of India and of the United Kingdom.” By JOSEPH WALTON.

APRIL 5.—“Telegraph Communication between England and India: its Present Condition and Future Developments.” By E. O. WALKER, C.I.E., M.I.E.E., formerly of the Government of India Telegraph Department.

APRIL 26.—“Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh.” By SIR AUCLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieutenant-Governor of the North-West Provinces and Oudh.

MAY 25.—“Chota Nagpore: its Mineral Wealth and its value to India.” By J. F. HEWITT, late Bengal Civil Service. SIR ALEXANDER WILSON, formerly President of the Bengal Chamber of Commerce, will preside.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on the following Tuesdays, at Half-past Four or Eight o'clock :—

JANUARY 23.—“Morocco.” By Captain ROLLESTON.

FEBRUARY 20.—“The Antwerp Exhibition, 1894.” By EDOUARD SÈVE.

MARCH 6.—“The Industrial Resources of Russia, Siberia, and the New Railway.” By E. A. CAZALET.

APRIL 17.—“Paraguay.” By A. F. BAILLIE.

MAY 1.—

MAY 29.—“Education in Victoria.” By Prof. C. H. PEARSON, M.A., LL.D.

APPLIED-ART SECTION.

The meetings of this Section will take place on the following Tuesday Evenings, at Eight o'clock :—

JANUARY 30.—“The Adam Architecture in London.” By PERCY FITZGERALD, M.A.

FEBRUARY 13.—“Modern Development of Illustrated Journalism.” By HORACE TOWNSEND.

FEBRUARY 27.—“Goldsmiths' Work: Past and Present.” By Mrs. PHILIP NEWMAN.

MARCH 13.—

APRIL 10.—“The Evolution of Decorative Art.” By HENRY BALFOUR, M.A.

MAY 8.—“Pewter.” By J. STARKIE GARDNER.

CANTOR LECTURES.

The following courses of Cantor lectures will be delivered on Monday Evenings, at Eight o'clock :—

PROFESSOR FRANK CLOWES, D.Sc., “The Detection and Measurement of Inflammable Gas and Vapour in the Air.” Four Lectures. January 22, 29; February 5, 12.

HUGH STANNUS, F.R.I.B.A., “The Decorative Treatment of Traditional Foliage.” Four Lectures. February 19, 26; March 5, 12.

CAPTAIN W. DE W. ABNEY, C.B., F.R.S., “Photometry.” Three Lectures. April 2, 9, 16.

HENRY CHARLES JENKINS, A.M.Inst.C.E. “Typewriting Machines.” Two Lectures. April 30; May 7.

JUVENILE LECTURES.

Two lectures, suitable for a juvenile audience, will be delivered by WALTER GARDINER, M.A., F.R.S., on “Plants: their Foes and Defences,” on Wednesday evenings, January 3 and 10, 1894, at 7 p.m.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 1.—Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. Prof. Lobley, “Endurance of Cosmical Conditions.”

London Institution, Finsbury-circus, E.C., 4 p.m. (Juvenile Lectures.) Mr. H. J. Mackinder, “Magellan.”

TUESDAY, JAN. 2.—Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lectures.) Prof. Dewar, “Air—Gaseous and Liquid.” (Lecture III.)

WEDNESDAY, JAN. 3.—SOCIETY OF ARTS, John-street, Adelphi, W.C., 7 p.m. (Juvenile Lectures.) Prof. W. Gardiner, “Plants—their foes and defences.” (Lecture I.)

THURSDAY, JAN. 4.—London Institution, Finsbury-circus, E.C., 6 p.m. Mr. W. Tallack, “Prisons and Criminal Treatment.”

Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lectures.) Prof. Dewar, “Air—Gaseous and Liquid.” (Lecture IV.)

FRIDAY, JAN. 5.—Geologists' Association, University College, W.C., 8 p.m. Dr. W. Frazer Hume, “The Genesis of the Chalk.”

SATURDAY, JAN. 6.—Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lectures.) Prof. Dewar, “Air—Gaseous and Liquid.” (Lecture V.)

Journal of the Society of Arts.

No. 2,146. VOL. XLII.

FRIDAY, JANUARY 5, 1894.

All communications for the Society should be addressed to
the Secretary, John-street, Adelphi, London, W.C.

Notices.

JUVENILE LECTURES.

On Wednesday evening, the 3rd inst., Mr. WALTER GARDINER, M.A., F.R.S., delivered the first of his course of Juvenile Lectures on "Plants: their Foes and Defences." The lecturer opened his subject by pointing out that no class of living beings had more persistent and remorseless foes than these plants, since they were preyed upon, and, ultimately, formed the food of the whole of the animal kingdom. The enemies, however, came not alone from the outside, for there was a struggle for existence among the plants themselves, which was seen wherever they grew, and particularly in the tropical forest, where the parasite fig climbed over the jack tree and eventually suffocated its foster mother.

The *Victoria regia*, found on the Amazon, was given as an instance of the defences which nature provides for the plant in many cases, the back of the large leaf exhibiting a marvellous instance of protective design. Sleep movements, by which a smaller surface of the plant is exposed to the cold, exhibited another class of defence, and protections against tropical sun and tropical rain were also alluded to. In many plants special mechanisms existed to protect the young delicate bud, and it was not uncommon to find the whole of the bud and the young leaves coated with a gum-resin, secreted by special hairs which varnished the whole structure, and prevented the loss of water so necessary to life in times of drought. Mr. Gardiner then described how the nutrition of plants was produced by the evaporation of water, and the retention of the salts suspended in the water.

In conclusion, the lecturer described some experiments of his own on a filamentous alga. He showed that it carefully protects its chlorophyll plate from too bright light by turning it so that it shall receive the proper amount only. Should external conditions be

exceptionally unfavourable, the protoplasm, the living part of the various cells, powerfully contracts, and the filament resolves itself into its various constituent units, which sink to the bottom of the river or pond, and there divide up and start afresh.

The second lecture will be delivered on Wednesday evening next, 10th inst., at 7 p.m.

INDIAN SECTION.

The Council of the Society of Arts have made arrangements with the Executive Council of the Imperial Institute for three of the Meetings of the Indian Section to be held at the Imperial Institute. The meetings of Thursdays, January 18, February 8, and March 22, will therefore be held in the Hall of the Institute, at 8.30 p.m.

Proceedings of the Society.

CANTOR LECTURES.

THE ART OF BOOK AND NEWSPAPER ILLUSTRATION.

BY HENRY BLACKBURN.

Lecture II.—Delivered December 4th, 1893.

THE ENGRAVER.

On some methods of reproducing drawings and photographs for the press—The substitution of photographs and mechanical engraving for handwork—Specimens of the newest processes of illustration.

Last week we saw on the screen a number of enlargements of drawings which had been reproduced successfully by the common relief processes, suitable for the type press. The most interesting and suggestive to students were those drawn by painters, each adopting his own method of expressing, in black and white line, the effect and spirit of his picture. The result in most cases showed a freedom of handling, and an unconventional treatment of line drawing to give tones and values, in striking contrast to the majority of process work. Some of these were only sketches, and on various kinds of paper or board; but the artists knew what they wanted to express, and took the readiest and simplest method to attain it. They had dwelt for months on their subject, they knew the picture by heart, as the saying is, hence the value to us of their suggestive lines. These drawings (examined with the results when reproduced) form together I

believe, the soundest teaching in black and white work.

Let us now look at a pen drawing by Mr. H. S. Marks, R.A., and explain shortly the method of its reproduction. This drawing [here enlarged on the screen] was about 7 in. by 5 in.; it is thoroughly suitable for reproduction on a much smaller scale (say 3 in.) if necessary. Here every line tells, and none are superfluous; the figure of the monk, the texture of his dress, the door behind him, and the grass growing between form a picture, the lines of which harmonise well with the type of a book. In this deliberate, careful drawing, in which white paper plays by far the principal part, the lighting of the picture is considered and the balance of a decorative page; a scientific example of the art of leaving out—of ‘the value of a line.’*

Drawings thus made, upon Bristol board or paper of that surface, with black ink, Indian ink, or any of the numerous inks now in use, which dries with a dull, not shiny, surface, will always reproduce well. The pen should be of medium point, or a brush may be used as a pen. The lines should be clean and sharp, and are capable of much variation in style and treatment, as we saw in the various examples last week. I purposely do not dwell here upon some special surfaces and papers by which extraordinary effects may be produced sometimes by the line processes; there is too much tendency already with the artist to be interested in the mechanical side.

PHOTO-ZINC PROCESS.

Now, to turn the drawing before you into a suitable block, the first process is to photograph it to the size required (say 5 by 4), and transfer the negative on to a sensitised zinc plate. This print, or photographic image of the drawing lying upon the zinc plate, is of greasy substance (bichromate of potash and gelatine), and is afterwards inked up with a roller; the plate is then immersed in a bath of nitric acid and ether, which cuts away what were the white parts on the paper, leaving the lines of the drawing in relief. This “biting in,” as it is called, requires considerable experience, according to the nature of the drawing. Thus, the lines are turned into metal in a few hours, and the plate when mounted on wood to the height of type-letters, is ready to

be printed from, if necessary, at the rate of several thousands an hour.

The best drawing for process reproduction is one that requires little or no touching on the part of the engraver or maker of the blocks; but it is difficult to impress on the artistic mind the necessity of conforming to certain rules. Some cannot draw firm clean lines at all, and *should not attempt them*. Few allow sufficiently for the result of reduction, and the necessary thickening of some lines.* The results are often a matter of touch and temperament. Some artists are naturally unfitted for line work; the rules which would apply to one are almost useless to another. Again, there is great inequality in the making of these cheap zinc blocks, however well the drawings may be made; they require more care and experience in developing than is generally supposed.

GELATINE RELIEF PROCESS.

Let us look now at the enlargement of a line drawing which is more difficult to reproduce; a portrait by the late Frank Holl, R.A. (drawn on Whatman paper, 4½ in. by 3½ in.), in which there are many pale, uncertain, and complicated lines which could not be produced well by the process just described. Here a more delicate and sensitive method is necessary to obtain a relief block. It is called the “gelatine process,” or the “Gillot process.”

The drawing is photographed to the required size (as before), and the *negative* laid upon a glass plate (previously coated with a mixture of gelatine and bichromate of potash). The part of this thin, sensitive film, exposed to the light, is absorbent, and when immersed in water swells up. The part protected from the light by the lines of the drawing remains near the surface of the glass. Thus you have a negative from which a metal cast can be taken, leaving the lines in relief as in the zinc process. In skilful hands this process admits of more delicate gradations, and the pale, uncertain lines in the drawing before us can be reproduced with tolerable fidelity. The blocks take longer to make, and are double the price—roughly, 1s. per square inch—of the first process described. There is no process yet invented which gives better results from a pen and ink drawing for the type-press. These blocks when completed have a copper surface. The reproductions of pencil, chalk, or charcoal

* The young “pen and ink artist” avoids backgrounds, or renders them by a series of unmeaning scratches, he does not consider enough the true “lighting of a picture,” as we shall see further on,

* All drawings for reproduction should be marked in the margin by the artist as to the amount of reduction intended. It is a useful guide to all concerned in publication.

drawings by the above processes are nearly always failures, as we may see in the best artistic books and magazines to-day. I will refer to them presently.

For those who cannot draw easily with the pen, there are several kinds of grained papers which render drawings suitable for reproduction. The first is a paper with black lines imprinted upon it on a material suitable for scraping out to get lights, and strengthening to get solid blacks. The drawings thus made can be reproduced in relief like line drawings, taking care not to reduce the black grain much or it becomes "spotty." Another paper largely used has a white grain, a specimen of which I will show you presently on the screen; and there are other variations of grained papers on which we will not dwell.*

Here the question may arise in many minds, are these contrivances with their mechanical lines for producing effect, worthy of the time and attention which has been bestowed upon them. I think it is very doubtful if much work ought to be produced by these means; and certainly in the hands of the unskilled, the results would prove disastrous. A painter may use them for sketches. Mr. Compton, as you see, can express very rapidly, by scraping out the lights and strengthening the darks, a snow-drift or the surfaces of a glacier. The late C. J. Watson and the French artist, M. Bistagne, have shown us how the white-grained paper can be played with, in artistic hands, to give the effect of a picture in a quarter of an hour. [Reference to enlargements on the screen.]

MECHANICAL DOTS.

The increased use of mechanical dots to give shadow and colour to a pure line drawing is always to be regretted, whether it be applied to a necessarily hasty newspaper sketch, or to one of Vierge's handsomely printed illustrations for the "Pablo di Segovia." One cannot condemn too strongly this system, so freely used in continental illustrated sheets, which, in the most skilful hands, seems a degradation of the art of illustration. These dots and lines, used for shadow, or tone, are laid upon the plate by the maker of the block, the artist indicating, by a blue pencil mark, the parts of a drawing to be so manipulated; and as the illustrator has not seen the effect on his own line drawing, the results are often

a surprise to everyone concerned. I wish these ingenious contrivances were more worthy of an artist's attention. Nothing but the speed with which a sketch for a newspaper can be thus made seems to excuse its use. Hurry is the secret and the mischief of it all.

Here is an example taken from an English print, by which you see that all daylight has been taken ruthlessly from an open air sketch. The system is tempting to the hurried illustrator; he has only to draw in line (or outline, which is worse), and then mark where the tint is to appear; and the dots are laid on the zinc plate by the maker of the blocks.

In the enlargements before you (referring to two examples from the *Daily Graphic*; one partly and one wholly covered with dots) it will be obvious that the artist's sketch is injured by this treatment, that in fact the result is not artistic at all. Nothing but high pressure or incompetence on the part of the illustrator can excuse this mechanical appliance to an incomplete drawing. Again I must remind you that these results are not the fault of the "process," or of the "process man." But the system is growing in every direction to save time and trouble, and is lowering the standard of topical illustrations. And it is this system (*inter alia*) which, I believe, is to be taught in technical schools, where the knowledge of process is taking the place of wood engraving.*

The question is again uppermost in the mind, are such mechanical appliances ("dodges," I venture to call them) worthy the serious attention of artists; and can any good arise in imparting such knowledge to youthful illustrators in technical schools? Wood engraving was a craft to be learned, with a career for the apprentice. *There is no similar career for a lad by learning the "processes" at technical schools*; and nothing but disappointment before him if he learns the mechanism before he is an educated and qualified artist.

* The rendering of a chalk or pencil drawing into a relief block, to be printed on rapid machines with inferior paper and ink, is another branch of process which I think the student of art had better not know much about, for the process has never been successful under the best conditions. He would be better occupied in learning DRAWING ON STONE, an art which does not come into the scope of these lectures, as it is seldom used in book illustration and cannot be printed at the type-press.

It is well worthy of study now, for the art is being revived in England on account of the greater facilities for printing than formerly. It is possible to obtain excellent results from chalk and pencil drawings in intaglio; photographed and printed as a copper-plate; as may be seen in the specimens by the Autotype Company on these walls.

* Mr. C. G. Harper, in his excellent book on "English Pen Artists," has treated of other ways in which drawings on prepared papers may be manipulated for the type-press.

It should be mentioned that all wood or steel engravings reproduce easily by the common zinc line process, but the reproductions are apt to lose brightness, and if much reduced break up or become spotty. Mention should be made also of drawing on prepared transfer paper with autographic ink, which is transferred to zinc without the aid of photography, a process very useful for rapid and common work; but it is irksome to the artist and not capable of very good results; moreover the drawing has often to be minute, as the reproduction has to be the same size as the original.

HALF-TONE PROCESS.

I now come to the method of reproducing wash drawings and photographs; on blocks suitable for printing at the type-press, commonly known as the Meisenbach or "half-tone process;" a most ingenious and valuable invention, which, in clever hands, is capable of artistic results, but which in common use has cast a gloom over our illustrations in books and newspapers.

Now, to make these blocks; as there are no lines or whites in a painting, or from a photograph from nature, it is necessary to obtain some kind of grain, or interstices of white, on the zinc plate, as in a mezzotint. So between the drawing or photographic print to be reproduced, and the camera, glass screens, covered with lines or dots, are interposed, varying in strength according to the light and shade required; thus turning the image of the wash drawing practically into "line," with sufficient interstices of white for printing purposes.

Thus, all drawings in wash, chalk, pencil, &c., that will not reproduce by the direct line processes, already referred to, are treated for printing at the type-press, and thus the uniform, monotonous dulness with which we are all familiar, pervades the page.

The artist who draws in wash with body colour, or paints in oils in monochrome, for this process, will see at once that his high lights will be lost, and his strongest effects neutralised, under this effect of gauze; in short, that there is no longer any breadth of white or black in his picture; and so for pictorial purposes, the illustrator who draws in wash has to *force his effect*, and exaggerate his lights and shades, avoiding too delicate gradation; and in his different tints keeping, so to speak, to one octave instead of two. Thus, also for this process, to obtain brightness and cheap effect, the illustrator of to-day often avoids backgrounds altogether.

Some excellent results (which I will show you presently on the screen) may be obtained by experienced and practised draughtsmen, if their work is well reproduced with a fine grain, and printed carefully on good paper. But where the block has to be prepared for printing, say 5,000 an hour off rotary machines, a coarser grain has to be used, producing the "Berlin wool pattern" effect you see before you.

There are many ways by which drawings unsuitable for the relief-toned processes are made available. Great advances have been made in the "screening" of pencil drawings where a great deal of white has to be left. You may trace the screening on every part of the enlarged proof before you. [Reproduction of a pencil sketch by Mr. Melton Prior.] These two wash drawings by Mr. S. Begg and Mr. Greville Manton, which have appeared lately in the *Black and White* newspaper, are good examples of the way to draw for reproduction; the artists have, you will notice, met the process half way, they have been careful to use broad, clear, firm washes, and they have done them with a certain hand, the result of experience. If, in the endeavour to get the best results out of a few tones by the mechanical process, their work lacks some artistic qualities, it is almost a necessity; but the tendency of this most modern form of illustration is to think too much of *technique*. But with the utmost care and patience on the part of the artist, these wash drawings, rendered by the half-tone process, are uncertain and artistically incomplete. It is more suitable for the rendering of sketches. Of the illustrators who use this process in a more free and easy way we will now take an example [an enlarged wash drawing was shown upon the screen].

Here truths of light and shade are disregarded, figures stand out in unnatural blackness against white paper, and flat mechanical shadows are cast upon nothing. Only sheer ability on the part of a few modern illustrators has saved these coarse ungainly sketches from universal condemnation. But the splashes, and spots, and stains, which are taking the place of more serious work in illustration, has become a vogue in 1893. The sketch is made in two or three hours, instead of a week; the process is much cheaper than wood engraving. The public is satisfied with a sketch where formerly a finished illustration was required, if the subject be treated dramatically and in a lively manner. If it comes out an unsightly smear on the page, it answers the purpose of topical

illustration, and apparently suits the times. It is scarcely too much to say that this example would not have been tolerated a few years ago. But it is the taste of the times to which the modern illustrator has adapted himself; and it is little short of a revolution in illustration, of which we do not yet see the end. One thing we must continuously bear in mind, that these hastily produced blotches called illustrations, which disfigure the pages of so many books and magazines, are the result of want of care on the part of the artist rather than of the maker of the blocks. The latter are, according to my experience, the most patient and painstaking of operatives.

The result of all this—a very serious one to the artist as far as we can see ahead—is the gradual substitution of photographs from life for any other form of illustrations. The Meisenbach reproduction of a photograph I now show you [the full length figure of the Lady Mayoress, photographed by Messrs. Russell, of Baker-street] answers the purpose of the editor of a newspaper to fill a page of his paper, where formerly artists and engravers would have been employed. The excuse for it is that the details of the dress are so well rendered on the block as to answer the purpose of a fashion plate, apparently a most important matter.

Now let us see what becomes of a very artistic photograph when put through the half tone process. Here is the photographic print from a painting by M. Jules Léfèvre [portrait of girl reading, shown on the screen]. This excellent silver print, full of delicate gradations and strong effects, appears on the plate through the film of gauze, dull, flat, and comparatively uninteresting; but the expression of the original is given with more fidelity than could be done by any ordinary wood engraving. To touch this on the negative and bring out the lights and accents of the picture is the common thing to do by the makers of the blocks; but it is a hazardous process at the best, when dealing with the copy of a painting. I mention it to show where hand-work in the half tone process first comes in. The block, when made, is also often touched up by an engraver in places, especially where spotty or too dark; on this work many who were formerly wood-engravers now find employment.

But the ideal illustration by process, whether from a line drawing, wash, or photograph, it cannot be repeated too often, is the one which requires the least manipulating on

the part of the maker of the block, who has seldom, or never, the opportunity to attend to it properly. In the case of the reproduction of photographs, especially, which we are now considering, much may be done by working up a platinotype print before giving it out to be made into a block. Much depends here upon the artistic knowledge of editors and publishers, who have it in their power to produce good or bad illustrations from the same original. The makers of these blocks being confined to time and price, are practically powerless.

Here let us pause for a moment to consider the material of which one number of an illustrated paper (*Sketch*) is made up, and how far the artist and wood engraver has part in it. It will be instructive from an economic point of view. I take a copy of *Sketch* because it is a typical and quite "up to date" publication, vieing, in circulation and importance, with the *Illustrated London News*, both published by the same proprietors. In one number there are upwards of 30 pages, 10 being advertisements. There are in all 151 illustrations, of which 63 appear in the text part, and 88 in the advertisement pages. Out of these text illustrations, 24 are from original drawings or sketches. Next are 26 photographs from life (several being full pages), and 13 reproductions from old engravings, &c., reproduced by mechanical processes—in all 63. Some of the pages reproduced from photographs are undeniably good, and interesting to the public, as is evidenced by the popularity of this paper alone. In the advertisement portion are 88 illustrations (including many small ones), 85 of which have been engraved on wood; a number of them are electrotypes from old blocks, but there are many new ones every week. The reason for using wood engraving largely for advertisements is, that wood blocks print more easily than "process," when mixed with the type, and print better (being cut deeper on the block), where inferior paper and ink are employed. But this class of wood engraving may be summed up in the words of one of the craft to me lately:—"It is not worth £2 a week to anybody." (I will refer to the better class of wood engraving, when speaking of books next week.)

Thus, it will be seen that, in the "text" part of this newspaper, two-thirds of the illustrations have been produced without the aid of either artist or engraver!

To turn to other subjects where the photo-

grapher is the illustrator. The photographer goes down a mine with his apparatus, and takes a series of views of the workings, which could probably have been done by no other means. Under most difficult circumstances he sets his camera, and by the aid of the magnesium flash-light gives us groups of figures at work amidst gloomy surroundings. Whether these are not both artistic and valuable as illustrations I leave you to judge. [Here two slides, taken in the Cambrian lead mines by Mr. J. C. Burrow, of Camborne, were shown, and others were exhibited on the walls.] The remarkable part, artistically, is the good colour and grouping of figures. One great value of these illustrations consists in the clear definition of detail. These photographs are shortly to be published in a book by Mr. Burrow and Mr. Thomas.

Another instance of the use of photography in illustration. Mr. Frederick Villiers, the special artist at Chicago for the *Black and White* newspaper, made a startling statement lately in this room. He said that out of some 150 subjects which he took in Chicago not more than half-a-dozen were drawn by him; all the rest being "snap shot" photographs. Some were very good, could hardly be better, the result of many hours' waiting for the favourable grouping of figures. That he would redraw some of them with his clever pencil for this newspaper is possible, but observe the part photography plays in the matter. I could mention many instances where the photographer and his models are producing illustrations of a dramatic kind, a system which cannot be ignored. (In America a novel has been thus illustrated both in figure and landscape.)

The last example of the photographer as illustrator, which can be given here, is where a photograph from life engraved on wood is published as a vignette illustration. [Slide from the *Graphic* of 28th October, 1893.] It is worth observing, because it has been turned into line by the wood engraver, and serves for printing purposes as a popular illustration. The original might, perhaps, have been more gracefully posed, and the effect may be to a certain extent, a "fluke," but it is pretty as a vignette, and pleases the public. There are hundreds of such subjects now produced by the joint aid of the photographer and the process engraver.

Here we may observe that it is not the artist and the wood engraver who are "working hand-in-hand" in the production of the great

majority of illustrations, as in America, but the photographer and the maker of process blocks. This is significant. Happily for us there is much that the photographer cannot do pictorially. But the photographer is, as I said, marching on and on, and the line of demarcation between original and photographic illustrations is less marked than formerly.

The photographer's daughter goes to an art school, and her influence is shown clearly in the exhibitions of the photographic societies. This influence and this movement is so strong—and vital to the artist—that I feel it cannot be emphasised too much. The photographer is ever in our midst, correcting our drawing with facts and details which no human eye can see, and no one mind can take in at once.

Of the obligations of artists to photographers a book might be written. The benefits are not, as a rule, unacknowledged; nor are the bad influences of photography always noticed. That is to say, that before the days of photography, the artist made himself acquainted with many things necessary to his art, for which he now depends upon the photographic lens; in short, he uses his powers of observation less than he did a few years ago. That the photographer leads him astray sometimes, is another matter.

Whatever developments may await the art of photography, says Mr. William Small in 1893, "it will never take good work out of a good artist's hands." In line work (the best and surest for the processes) photography can only be the servant of the artist, not the competitor—and in this direction there is much employment to be looked for. But in whatever material or style, newspaper illustrations to hold their own, must be of the best. Let them be as slight as you please, if they be original and good. At present we are casting off—ungratefully it would seem—the experience of the life time of the wood engraver, and are setting in its place an art half developed, half studied, full of crudities and discords. The illustrations which succeed in books and newspapers succeed, for the most part, from sheer ability on the part of the artist; they are full of ability, but, as a rule, are bad examples for students to copy. "Time is money" with these brilliant executants; they have no time to study the value of a line, nor the requirements of the processes, and so a number of drawings are handed to the photo-engravers—which are often quite unfitted for mechanical reproduction—to be produced literally, in a few hours. It is an age

of vivacity, daring originality, and reckless achievement in illustration. "Take it up, look at it, and throw it down," is the order of the day. But there is no reason, but laziness, why the work done "to look at," should not be as good as the artist can afford to make it. The manufacturer of paper hangings or printed cottons will often print only a limited quantity of one design, no matter how beautiful, and then go on to another. So much the better for the designer; but he would not keep employment if he did not do his best, no matter whether his work is to last for a day or for a year. The life of a single number of an illustrated newspaper is a week, and of an illustrated book about a year.

The young illustrators on the *Daily Graphic*—notably Mr. Reginald Cleaver—obtain the maximum of effect with the minimum of lines. Thus Caldecott worked, spending hours sometimes studying the art of leaving out. Charles Keene's example may well be followed, trying drawing after drawing, no matter how trivial the subject, until he was satisfied that it was right. "Either right or wrong," he used to say; "'right enough' will not do for me."

Another influence on modern illustrations—for good or bad—is the electric light. It enables the photographic operator to be independent of dark and foggy days, and to put a search light upon objects which otherwise could not be utilised. So far good. To the illustrator this aid is often a doubtful advantage. The late Charles Keene (with whom I have had many conversations on this subject) predicted a general deterioration in the quality of illustrations from what he called "unnatural and impossible effects," and he made one or two illustrations in *Punch* of figures seen under the then—(10 or 15 years ago)—novel conditions of electric street lighting, one of which I will show you on the screen. [Illustration of a gentleman who has been dining, returning home through a street lighted by electric lamps.] Charles Keene's predictions have come true, we now see the glare of the magnesium light on many a page, and the unthinking public is dazzled every week in the illustrated sheets with these "unnatural and impossible effects." Thus it has come about that what was looked upon by Charles Keene as garish, exaggerated, and untrue in effect, is accepted to-day by the majority of people as a lively and legitimate method of illustration.

PROCESS-BLOCK MAKERS.

I must mention one more influence on the

young illustrator. The "process man," the teacher and inciter to achievements by this or that process, is not usually an "artist" in the true sense of the word. He knows better than any one else what lines he can reproduce, and especially what kind of drawing is best adapted for his own process. He will probably tell the young draughtsman best what materials to use, what amount of reduction his drawings will bear, and other things of a purely technical, not to say businesslike character. Let me not be understood to disparage the work of photo-engravers and others engaged on these processes; on the contrary, the amount of patience, industry, activity, and anxious care bestowed upon the reproduction of drawings at the present time is astonishing, and deserves our gratitude. Their work in England is a new industry of an important kind, in which art and craft are bound up together. The photo-engravers are our faithful friends, and are ready to serve us well, if only the public (represented by editors and publishers) will recognise that *good work requires good pay*. The day has past when "process work" is to be looked down upon as only fit for the cheapest, most inferior, and inartistic results.

There is no doubt that the makers of process blocks are the best instructors as to the results to be obtained by certain lines and combinations of lines; but in the majority of cases they will tell the artist too much, and lead him to take too much interest in the mechanical side of the business. His best protection against this tendency, his whole armour and coat of mail, is *to be an artist first and an illustrator afterwards*.

This is the sum of the matter. Perhaps some of the examples I have brought here to-night may help us, and lead to a more thorough testing of results by capable men.

[Amongst the objects lent for exhibition at this lecture were proofs of various processes:—

1. Relief blocks, from the Meisenbach Company, Messrs. André and Sleigh, the Art Reproduction Company, the Direct Photograph Company, the Typographic Etching Company, Mr. Carl Hentschel, Mr. Dallas, Messrs. Dellagana and Co., Messrs. Vincent and Hahn, and others.

2. *Intaglio* plates, from Messrs. Boussod, Valadon, and Co., the Autotype Company, Mr. Alfred Dawson, Mr. Dallas, and others.

3. Photographs from Mr. J. C. Hollyer, Messrs. Russell and Sons, Mr. Burrow, of Camborne, and others.

4. Wood engraving by the proprietors of the *Graphic*, Mr. Biscombe Gardner, and others.

Also drawings and examples of illustration from the proprietors of the *Illustrated London News*, the *Graphic*, *Black and White*, the *Builder*, the *Architect*, the *Building News*, *St. James' Budget*, the *Idler*, &c.; also of process papers and illustrators' materials from Messrs. Lechertier, Barbe, and Messrs. Cornelissen and Co.]

Miscellaneous.

REPORT ON CALIFORNIA WINES AND BRANDIES EXHIBITED AT THE WORLD'S COLUMBIAN EXPOSITION, CHICAGO, U.S.A., 1893.

Examined and reported on by CHAS. F. P. OLDHAM, Member of the Firm of Grierson, Oldham & Co., 11 Regent-street, London, S.W.; at the request of the British Royal Commission.

Wines and brandies submitted for examination, 370 samples, comprising products from 53 different individuals and firms, classified as follows:—

DRY WHITE WINES

- 64 samples described as of Rhenish type.
- 48 " " Sauterne type.
- 11 " " White Burgundy type.
- 6 " miscellaneous of various styles.

DRY RED WINES.

- 30 samples described as of Médoc type.
- 24 " " Burgundy type.
- 53 " miscellaneous, clarets of various styles.

SWEET OR FORTIFIED WINES.

- 29 samples described as of port type.
- 20 " " sherry type.
- 39 " miscellaneous of various styles.

SPARKLING WINES.

5 samples described as fermented in bottle, according to the French methods of champagne making.

BRANDIES.

41 samples of various makes and ages.

GENERAL CHARACTERISTICS.

(The heads enumerated are those requested to be reported on.)

1. *Evidences of Purity.*—From careful examination, I feel convinced that all the samples submitted to me were perfectly pure juice of the grape, fermented or distilled in a legitimate manner, without the use of foreign substances, flavors or essences.

2. *Indications of Intelligent Supervision of the Primary Operations of Fermentation and Distillation.*—I was particularly struck with the excellent manner

in which nearly all the white wines seem to have been fermented. One or two, I should say, had been left a little long on their skins, and consequently are somewhat deeper in colour than is desirable; but with the exception of these, the fermentations appear to have been excellent. The majority of the red wines show also, that they must have been well cared for in this particular.

With regard to the brandies, nearly the whole of them appear to have been well and carefully distilled.

3. *Indications of Methods of Maturing and Preparing for Bottling.*—Most of the white wines have, undoubtedly, been well and carefully matured in wood; but a few, I am led to think, must have been left too long in cask, or kept in a hot or dry cellar, the consequence being, that they are rather of too deep a colour, and have a slightly sherry taste. Probably nearly all these wines were good when first made, and the defects which some of them now show, may be attributed to faults in maturing while in wood.

Some of the white wines had, evidently, an excess of albumen when they were bottled, as evinced by the deposit thrown. A large number were, however, brought into excellent condition for bottling, and have, in consequence, kept perfectly brilliant.

The maturing in wood of some of the red wines does not appear to me to have been so satisfactory as in the case of the white. Many of the red wines have no doubt been carefully matured in cool cellars, and in small packages; but others, again, have the appearance of having been kept in large vats, in a hot and uneven temperature. I am induced to think that nearly all the red wines must have been good when young, and probably for a year after, and that the defects now evinced, by some of them, are due to the want of good, cool, underground cellarage—where an even temperature can be maintained—or to having been kept in large vats as alluded to above. Undoubtedly also, a few of the red wines had been left too long in wood before bottling. With these few exceptions, the red wines show great merit, and many of those classified under Medoc types, are really very excellent.

4. *Evidences of Skill in Bottling.*—By far the greater majority of the samples submitted showed that great care had been taken in this important particular. In a few cases, I found that the dry red and white wines had not been filled up as close to the cork as—in my opinion—is desirable.

5. *Evidences of Critical Knowledge in the Classification of Wines, as shown by names adopted to describe various types.*—As a rule, California wine producers seem to have aimed at following the European types as closely as possible; and as they grow European varieties of grapes almost exclusively, they describe their wines accordingly—that is to say, a wine made from Sauterne grapes is described by them as being of Sauterne type, and so on. In some instances, however, sufficient care does not seem to have been exercised in this matter.

6. *Style of Bottles, Labels, &c.*—The European

style of bottles has most generally been used. For instance: Wines described as of claret type have been put into French claret bottles, Burgundy into the ordinary French Burgundy bottle, hock into the German hock bottle, and Sauterne into the white French bottle. Amongst the port, sherry, brandy, and sweet wine types this uniformity has not been equally maintained. In most instances the bottles have been very nicely got up—bearing neat, plain labels—capsules being generally used, although in a few cases wax has been put in their place.

I would here remark, that it must be borne in mind that these criticisms are based upon standards of quality, such as would, I think, be most likely to find favour in a British market. It is quite probable, however, that in the American markets, such criticisms might not at all apply.

I think it right to mention that I was, to some extent, aided in my examination of these wines by the fact, that nearly all the wine districts in California are well known to me, and that I have, for some years now, been making a careful study of their produce. The wines of California must not be confounded

with other American wines made east of the Rocky Mountains, where, I believe, nothing but native vines are grown. In California, owing to the suitable soil and beautiful climate, all the finest European varieties are grown in great perfection, and as they bear there in a very luxuriant manner, there is little temptation to make wine of anything but the juice of the grape. The annual quantity made now is about twenty million gallons. A very much larger amount, however, can be produced when the demand justifies it, as there are considerable tracts of land suitable for vine culture still unplanted. Owing to the fact that the soil and climate in the best wine districts of California resemble closely those of some of the finest in France, and also that the vines grown there are the same, the wines frequently resemble, in many points, their well known European namesakes. Amongst the ordinary and moderate-priced wines I think there are a large number that are well suited to the English market.

From notes taken as I examined each sample, I select the following as being, in my opinion, the most worthy of remark and commendation:—

RHENISH TYPES.

Exhibitor.	Label.	Comments.
H. W. Crabb.....	Riesling	An excellent clean light wine, free from acidity, in good condition, well corked, and nicely labelled and capsuled.
C. P. Howes.....	Riesling	A good style of light Hock, nice light colour, in very good condition, well corked, nicely labelled.
F. Haesters	Johannisberg Riesling	A very pretty light wine, in good condition, no resemblance to Johannisberg Riesling, though so labelled.
Otto Normann	Riesling	An excellent style of Hock, good bouquet, nice colour, well kept; in my opinion, the best wine in this class.
T. Parrott	Rhine Wine, Type 1891	A very pretty wine, nice light colour, has been well kept, and is in perfect condition. To my mind it rather more like a Chablis than a Hock; very well corked.
J. P. Smith	Orleans Riesling, 1887	Very pretty wine of Chablis type, well kept, good bottle flavour, in excellent condition, although the cork was very badly put in bottle.
Beringer Bros.	Riesling	A pretty wine, good light colour, but a little acid for my taste.
Jacob Schram	Hock	A good, well-kept, pleasant wine, but hardly the character of a Hock.
Beringer Bros.	Old Hock	A good wine, in excellent condition, nice light colour, but, in my opinion, rather too acid.
Ewer and Atkinson	Hock	A very good wine, nice colour, unfortunately sample was a little "corky."
John Crellin and Sons.....	Riesling	A very pretty wine, of Hock type, good light colour, soft, smooth, and very pleasant, one of the best in this class.
John Crellin and Sons	Hock	A very pretty light wine, nice colour, excellent.
A. Haraszthy and Co.	Gutedel	A very pretty wine, nice colour.*
Los Gatos and Saratoga Wine Company	Riesling	A good clean wine of Chablis type.
William Wehner	Gutedel	Good clean wine, nice colour.

* Casks too heavily sulphured.

Exhibitor.	Label.	Comments.
C. Carpy and Co.....	Riesling	Nice clean wine, good colour.
H. Lefranc.....	Riesling	Very good clean wine, nice colour.
Italian Swiss Agricultural Colony	Burger	Very light, perfectly clean; an excellent sample of Burger; should be valuable for blending purposes.

SAUTERNE TYPES.

Geo. West and Sons	Haut-Sauterne	A good wine of Sauterne style, nice colour.*
Inglenook Vineyard	Sauterne.....	A nice wine, but hardly Sauterne character. This sample was not in very good condition.
G. C. P. Howes.....	Sauterne.....	Very pleasant wine of Sauterne style, good colour.
Chauché and Bon	Sauterne.....	A very good, dry type of Sauterne, nice colour.
Los Gatos and Saratoga Wine and Fruit Co.....	Sauterne.....	Very pretty wine indeed, clean and delicate. Not quite the Sauterne type; more of a Moselle in style.
J. Crellin and Sons	Sauterne.....	Good, clean, delicate, nice colour, Sauterne style.
A. Brun and Co.	Sauterne.....	Good, clean wine; not quite the colour or character of Sauterne, rather more like a Chablis, but good as a wine.
H. W. Crabb.....	Sauterne.....	Good, clean wine, nice colour; not quite the Sauterne style. This sample was a little flat.
Chauché and Bon.....	Haut-Sauterne	Very good wine indeed, nice colour, good condition.
California Wine Growers' Union	Sauterne.....	A very fair, sweet type, good colour, not much character; but sample was not in very good condition.
C. Carpy and Co.	Sauterne.....	Very good wine indeed, nice colour, in perfect condition; an excellent type of Sauterne.
Julius P. Smith.....	Haut-Sauterne, 1887	Very good style of wine, colour a little too high; more of a fine Chablis than a Sauterne.
J. P. Smith	Haut-Sauterne, 1888	Same remarks as apply to previous sample.
Beringer Bros.	Sauterne.....	Good, clean, dry wine, nice colour; but sample was not in very good condition.
Wm. Wehner	Sauterne.....	Very good wine, nice colour, Haut Sauterne style.
J. P. Smith	Haut Sauterne, 1891..	Excellent clean wine, rather too deep colour.
I. de Turk	Sauterne.....	A very nice wine, but scarcely Sauterne character.
J. Schram	Sauterne.....	Good, clean, dry wine, in fine condition; unlike Sauterne; put up in a Hock bottle.
California Wine Growers' Union.....	Sauterne	A good type of Sauterne, but sample in very cloudy condition.
Italian Swiss Agricultural Colony	Sauvignon	Good, clean, well made wine, adapted for blending.
F. W. Billings	Sauvignon Vert.....	Appears to be a straight Sauvignon Vert, clean and sound, a little bitter, only fit for blending.
J. Schram	Sauvignon Vert.....	A good clean sample of Sauvignon Vert in perfect condition, only fit for blending.

WHITE BURGUNDY TYPES.

Italian Swiss Agricultural Colony	Chablis	A pretty, light, delicate wine, in perfect condition.
C. C. McIver.....	Chablis	A nice wine, good colour.
H. W. Crabb.....	Chablis	A good delicate wine, nice colour, put up in a Hock bottle.
Italian Swiss Agricultural Colony	Pinot Blanc	A good wine of Chablis type, well made and kept, in very good condition.

* Casks too heavily sulphured.

Exhibitor.	Label.	Comments.
T. Parrott	White Burgundy, Mont-rachet Type	A good wine, but sample was in very bad condition.
Dr. J. A. Stewart	White Burgundy, 1891	A very clean, pretty wine, in excellent condition.
Chauché and Bon	Chablis	Good, clean wine, in fine condition, nice colour, considerable flavour and bouquet.

MISCELLANEOUS DRY WHITE WINES.

Italian Swiss Agricultural Colony	Chasselas	Good, clean, sound wine.
J. L. Beard	Golden Chasselas	Very good wine indeed, in perfect condition.
Italian Swiss Agricultural Colony	Pinot Gris	Good sound, well made wine, in excellent condition; the cork too soft.
Chauché and Bon	Jurançon	Splendid wine, very fine bouquet and flavour, in perfect condition; the finest type of white wine in the whole exhibit.
Italian Swiss Agricultural Colony	Dry Muscatel	A pretty light wine, but very little taste of Muscatel.

MISCELLANEOUS CLARET TYPES.

A. Erun and Co.	Zinfandel	A good, clean, well kept Zinfandel.
J. Crellin and Sons	Zinfandel	A good, sound, Zinfandel, in fine condition, good colour; there is a little bitterness in this wine, but that probably will disappear with age in bottle.
Los Gatos and Saratoga Wine and Fruit Company	Zinfandel	A good, sound, clean, delicate wine, in excellent condition.
H. B. Wagoner	Zinfandel	Good colour, fine condition.*
Otto Normann	Zinfandel	Good sound wine, nice colour.*
H. W. Crabb	Zinfandel	Good wine, soft and smooth, apparently has been well and largely blended with some other variety.
I. de Turk	Zinfandel	Good soft, smooth wine, nice colour, in first-rate condition, labelled "Zinfandel," but tastes as though blended with some other variety, and improved by the blend.
Julius P. Smith	Zinfandel, 1891	A very good sample of Zinfandel, delicate and free from acidity.
Italian, Swiss, Agricultural Colony	Zinfandel	Good sound, full-bodied wine.*
G. Migliavacca	Zinfandel, 1886	A very good, firm wine, deep colour, soft and smooth, in first-rate condition; has no resemblance to Zinfandel.
Italian, Swiss, Agricultural Colony	Mataro	A very good sound, well made wine, nice colour, perfect condition, very agreeable style.
F. W. Billings	Mondeuse, 1890	A very good, soft, agreeable wine, should blend well with Zinfandel.
Los Gatos and Saratoga Wine and Fruit Company	Claret X.X.	Good, clean, light wine, nice colour, good condition, very pretty style.
E. E. Goodrich	Table Wine	Good sound, very heavy wine, deep colour.
H. B. Wagoner	X X Claret	A big heavy wine, with deep colour, rather pronounced flavour.
H. W. Crabb	Claret	A nice delicate wine, perfect colour and condition, but a little too acid.
J. Crellin and Sons	Claret	Good wine, nice colour, perfect condition, very agreeable, in spite of a little bitter, or tannin taste.

* An excess of tannin.

Exhibitor.	Label.	Comments.
Inglenook Vineyard	Claret, 1882	A nice wine, good colour and condition, not very much character.
G. Migliavacca	Claret	A good, sound, deep coloured wine with considerable body, soft and smooth, but rather too heavy.
F. Albertz	Ch'au, Moulton.....	Very pretty, light wine, in good condition, nice light colour.
Chauché and Bon	Table Claret	Very fair wine, nice colour, good condition.
J. P. Smith	Claret, 1890	Very good, soft, smooth, full bodied, good colour and condition.
Geo. West and Son	Claret, 1888	Very fair wine, nice colour, good condition.
Geo. West and Son	Claret, 1887	Good, clean, well-made wine, nice colour, in excellent condition.
Beisinger Bros.	Claret	Good, light wine, nice colour, fine condition, just a little bitter taste.
Chauché and Bon	Claret (Grand Vin) ..	Good, sound, light wine, in perfect condition, but tastes a little "stalky."
Italian - Swiss Agricultural Colony	Barbera	Big, rich wine, soft and smooth, very good, though sample was not quite bright.
E. E. Goodrich.....	Claret Carignan.....	A good, clean, fairly light wine.

MEDOC TYPES

J. Gundlach and Co.	Chateau Gundlach ..	Excellent wine, in fine condition, soft and smooth good colour, full-bodied.
C. Carpy and Co.....	La Loma.....	Very good, soft, smooth wine, nice colour, free from acidity, an excellent full-bodied wine, with rather pronounced flavour.
John T. Doyle	Claret, 1886	An excellent wine, of good style, nice light colour, in perfect condition; more breed in this sample than in any other red wine exhibited.
John T. Doyle	Claret, 1886	Same style of wine as above, but not as well kept; rather too acid.
C. C. McIver	Cabernet.....	Very good, rather heavy, in excellent condition. If well kept, should develop into a fine wine, but will take some considerable time to come to perfection.*
C. P. Howes.....	Cabernet.....	A straight sample of Cabernet Sauvignon, very big, useful for blending.
J. Gundlach and Co.	Cabernet Sauvignon..	A very fine wine indeed, in perfect condition. A little too big for some people.
Napa Valley Wine Co.	Cabernet.....	Very pretty style of wine, not so heavy as some, good colour and condition, clean, but just a little "stalky."
J. P. Smith	Cabernet, 1890	A fine wine, in excellent condition, nice colour, not too heavy.
Otto Normann	Cabernet Sauvignon..	Very good wine, in excellent condition; should develop into fine wine, but very heavy indeed.
T. Parrott	Medoc, Chateau Margaux Type.	A fine, big, straight Cabernet Sauvignon; will probably take a long time to come to perfection. Intrinsically very fine wine; but, in my opinion, too heavy as it is.
Arpad Haraszthy and Co. ..	Chateau d'Orleans..	A fine, good style of wine, fit for present drinking, should go on improving in bottle.
J. P. Smith	Malbec, 1888.....	A good wine for blending purposes, has a fine bouquet, but a slight acid taste.
E. R. Lilienthal and Co. ..	Medoc, 1890	A very pretty wine, of lighter style than many, good bouquet, sample was a little flat.
Napa Valley Wine Company	Cabernet	Very pretty, light style, good bouquet, fit for present drinking, in good condition.

* Excess of tannin.

Exhibitor.	Label.	Comments.
I. de Turk.....	Cabernet, 1891	A beautiful soft wine, with nice bouquet, in perfect condition, should develop into a fine wine, though a little heavy.
Arpad Heraszthy and Co. ..	Cabernet Blend.....	Good style of wine, nice bouquet, in perfect condition.
Dr. J. S. Stewart.....	Haut Medoc, 1890 ..	A fine sample of Cabernet Sauvignon, in good condition, very heavy.
Dr. J. S. Stewart.....	Haut Medoc, 1891 ..	Same remarks as previous sample.
J. P. Smith	Malbec, 1891.....	Very good, soft, full-bodied, young wine, in fine condition.
John T. Doyle	Cabernet Franc, 1890	A very good wine indeed, nice colour, perfect condition, should develop beautifully with age in bottle.

BURGUNDY TYPE.

J. Crellin and Sons	Burgundy	Good, clean, light style, rather dry, in fine condition.
C. C. McIver.....	Burgundy	Good, soft, clean wine, in perfect condition, but without much character. In a claret bottle.
I. de Turk	Burgundy	Very good, smooth wine, in nice condition; very agreeable. In a claret bottle.
Chauché and Bon.....	Burgundy	A very good, soft, rich wine, in fine condition.
R. H. Delafield.....	Mataro	Nice, light wine, good condition.
Los Gatos and Saratoga Wine and Fruit Co.	Burgundy	Good, clean wine, in fine condition.
H. Lefranc.....	Burgundy	A very heavy, deep-coloured wine, in fine condition, but hardly Burgundy style.
J. Gundlach and Co.	Burgundy	Heavy, rich, deep-coloured, soft, and free from acidity.
J. P. Smith	Burgundy, 1891.....	Good, rich, young wine, in fine condition.
T. Parrott	Chambertin Style, 1888	Very good, full-bodied wine, in perfect condition, well kept.
J. Gundlach and Co.	Chambertin	Very fine, rich wine, good flavour, in splendid condition.
H. W. Crabb	Burgundy	A nice, clean, light wine, in good condition.
Arpad Haraszthy and Co. ..	Burgundy	Beautiful colour, good bouquet, in very fine condition, but rather much acid for my taste.
Napa Valley Wine Co.	Burgundy	Fine, rich wine, soft and smooth, in beautiful condition, nice colour.
Beringer Bros.	Burgundy, 1889.....	Good, full wine, in fine condition.
Italian - Swiss Agricultural Colony	Burgundy	A very pleasant wine with nice colour, and in perfect condition.
C. Carpy and Co.....	Burgundy	Good, full-bodied, soft and smooth, fine colour and condition.

BRANDIES.

H. Lefranc	Grape Brandy	Well made, clean.
T. Parrott	Fine Champagne Type, 1891.....	A good, clean brandy, with a pronounced aromatic taste and smell.
T. Parrott	Do. 1890.....	Good, clean, pretty brandy, should be very good when old.
W. Palmtag	Brandy	Nice clean brandy, well made, but just a little too sweet.
Italian - Swiss Agricultural Colony	Brandy	A good, pure, young brandy.
C. C. McIver	Brandy	A good brandy of pleasant style.
J. Gundlach and Co.....	Grape Brandy, 1885..	A very fair brandy of French style.
Los Gatos and Saratoga Wine and Fruit Co.	Brandy	Good, clean brandy.

Exhibitor.	Label.	Comments.
J. Gundlach and Co.....	Brandy, 1883.....	A good brandy of French style.
"	" 1882.....	Same remarks as above.
Ewer and Atkinson	Brandy, 1891.....	A very clean, straight brandy, delicate and agreeable.
Geo. West and Son*	Brandy, 1890.....	Very good style well made.
"	" 1888.....	Ditto. Ditto.
"	" 1886.....	Very good style, well made, a little too sweet.
"	" 1884.....	Very good style, well made.
"	" 1882.....	A good brandy, but a little coarse, and high colour.
"	" 1878.....	Good, clean, very dark colour.
"	" 1876.....	A good brandy, but a little coarse.
Barton Estate Vineyard Co.	Brandy	A good, clean, well made brandy.
Leland Stanford	Vina.....	There were nine samples of brandy in this exhibit, ranging from the years 1886 to 1892, and they were all good, well made brandies, that of 1889 being the best at the present moment, though the succeeding makes will probably, at the same age, be equally good. These samples were all freshly drawn from wood, whereas, the other exhibits were all bottled goods.
J. P. Smith	Brandy, 1891	Very good clean, pale brandy.

California State Viticultural Commission Experimental Distillates, made in 1886.

The grapes were from Livermore Valley, and were fermented without skins by the Commission, in small packages. The wine was distilled in a glass still. The first distillate was then reduced with water twenty-five per cent., and redistilled. This brandy has been kept in glass packages with perforated covers, so that the brandy is subject to the action of the air, and is, of course, quite white. The following are the varieties placed in, what I consider, the order of merit:—(1) Folle Blanche; (2) Blend of Folle Blanche, 2/3, and Colombar, 1/3; (3) Burger; (4) Mission.

SPARKLING WINE.

Exhibitor.	Label.	Comments.
Arpad Haraszthy and Co. ..	Eclipse, Extra Dry ..	An excellent wine, of champagne character, very clean, and free from acidity, in perfect condition.
Arpad Haraszthy and Co. ..	Eclipse Brut	A similar wine to the above, but considerably drier.
Arpad Haraszthy and Co. ..	Carte Blanche	A very agreeable, soft, smooth wine.
H. Lefranc.....	Extra Dry	A fair wine, not quite bright, had evidently been prepared some considerable time, good "mousseux." This wine had a slight sherry taste. The bottle was not at all well corked or foiled.
H. Lefranc.....	Dry	The same remarks apply to this sample as to the above, except that the wine was considerably brighter.

SHERRY TYPES.

Geo. West and Son.....	Sherry, 1882	A very fair, clean wine, unlike the Spanish style however.
C. C. McIver	Sherry.....	Clean, soft wine, somewhat of the golden sherry style.
J. Gundlach and Co.	Sherry.....	A fair, clean wine of golden sherry style, not as deep in colour, or as sweet as most of the California sherries exhibited.
I. de Turk.....	Sherry.....	Rather better style, a little lighter and drier than most.
Eisen Vineyard Co.	Sherry.....	Lighter in colour and drier, and rather better style than most.
Cordelia	Sherry.....	A very pretty style of light, sweet sherry, soft and smooth, very good of its sort, by far the best exhibited.

There were twenty samples of so-called "California Sherries" exhibited. The majority of them were, however, very poor indeed, and scarcely any bore a resemblance to the Spanish.

* The brandies of this exhibitor show great improvement from 1884 to 1890 over previous years, and, taken as a whole, they are probably the best and most reliable exhibited.

PORT TYPES.

Exhibitor.	Label.	Comments.
J. C. Merithew.....	Port.....	Fair colour, and not bad wine of its sort, though no resemblance to Portuguese Port.
George West and Son.....	Port, 1885	A clean, light, sweet wine, well made and aged. One of the best exhibited, though unlike Portuguese Port.
George West and Son.....	Port, 1886	The same remarks apply as to the previous wine.
J. P. Smith	Port, 1890	A very fair wine as a California Port, but no resemblance to Portuguese.
H. W. Crabb.....	Port, 1888	Same remarks as previous sample.
Eisen Vineyard Co.	Port.....	Very fair, clean, light, sweet California Port. Has a slight resemblance to Portuguese Port. Undoubtedly the best exhibited.
L. J. Rose.....	Port, 1876	A clean, old, sweet wine, the colour of Madeira, though no resemblance to Port.
Steinck and Bruning	Port.....	A fair, rich, full-bodied wine.

There were twenty-nine samples of so-called "California Port" exhibited, but scarcely any of them had the least resemblance to Portuguese Port. They were more like sweet Claret.

I am of opinion that there are certain districts of California which are well suited to the production of Port and Sherry types; and I have no doubt, if the same amount of care and study was given to them as has been given to the dry, red, and white wines, they would prove equally satisfactory.

MISCELLANEOUS SWEET WINES.

J. P. Smith	Angelica, 1890	A good rich Angelica.
L. Stanford ("Vina") ...	Angelica, 1882	Clean, very good indeed, by far the best exhibited.
Barton Vineyard Co.	Angelica.....	Very good sample of Angelica.
R. Delafield	Angelica.....	Very good, nice flavour; one of the best.
"	Muscatel.....	Good of its sort, though sample was cloudy.
Steinck and Bruning	Muscatel.....	Good, very sweet.
Italian - Swiss Agricultural Colony	Muscatel.....	Good, sweet, though little taste of muscatel.
H. B. Wagoner	Muscatel.....	Good, rich.
Beringer Bros.	Muscatel.....	Good, clean.
Eisen Vineyard Co.	Muscatel, 1876	Heavy, rich, very good of its sort.
Geo. West. and Son	Frontignan.....	Rich, with a good deal of flavour.
J. Gundlach and Co.	Tokay	One of the best, light and good.
"	Malaga	Rich, full wine of Malaga type, good of its sort.

Amongst the Claret and Sauterne types exhibited were several important samples submitted by Mr. Chas. A. Wetmore; but owing to the fact that Mr. Wetmore was appointed by the Viticultural Commission to arrange for this examination, he requested that his samples should not be reported on.

The samples were all tasted without my knowing at the time by whom exhibited.

The examination was made by numbers, and not by names, the key to them being given me when all "tasting" was finished, in order that I might place "Comments" against the Exhibitors' names.

Professor Wiley, Chief Chemist of the Agricultural Department of the United States, kindly assisted at the examination.

CHAS. F. OLDHAM.

Correspondence.

CARRIAGEWAY PAVEMENTS.

Mr. J. L. SPOOR (Borstal Manor Cement Works,

Rochester, Kent), writes:—It may be of interest to engineers to add to Mr. Faija's valuable remarks on the paper read by Mr. Isaacs, that a very great economy in the foundation of Carriage Way Pavements can be made by using cement of great fineness. Take for instance such cement as Mr. Isaacs specifies, viz., 10 per cent. residue on a sieve of 2,500 meshes, such cement would leave 20 per cent. on a sieve of 5,800 meshes, and it is an undoubted fact that such 20 per cent. residue can be reckoned as inert, and of no more value than sand. Take Mr. Faija's figures of the cost of cement and Thames ballast. The engineer who puts down pavement with a coarse cement, is actually paying 25s. per ton for 20 tons of sand in every 100 tons of cement, or, in other words, is paying £25 for 20 tons of sand, whereas if he bought fine cement, and found his own Thames ballast at 1s. 6d. per ton, it would cost him 30s.; hence his saving would be £22 10s. in every 100 tons of cement used. This is a very important factor in the cost of pavements, and one which deserves the attention of all concerned in foundations for carriageways.

General Notes.

EDUCATIONAL LECTURES.—A second course of ten lectures will be given by Mr. H. J. Mackinder, M.A., Reader in Geography at the University of Oxford, in the theatre of the Royal United Service Institution, on successive Thursdays, beginning on the second Thursday in January (the 11th), at 8 p.m. Admission to the opening lecture, at which the plan of the course will be explained, will be free. The titles of the ten lectures are as follows:—Course II. "The Coast-lands of the North Atlantic." (1) Introductory: the field of study defined and connected with that of Course I. (2) Spain and Gaul: a comparison and a contrast. (3) The Netherlands: compared physically and historically with England. (4) Britain: preliminary general survey. (5) England: the south-eastern focus of life. (6) England: the north-western focus of life. (7) Scotland and Ireland: compared and contrasted. (8) North America: preliminary study. (9) North America: historical study. (10) Some broad principles, deduced from the examples studied in Courses I. and II.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

JANUARY 17.—"White Lead Substitutes." By A. LAURIE, M.A. PROF. W. C. ROBERTS-AUSTEN, C.B., F.R.S., will preside.

JANUARY 24.—"American Carriages." By G. HERBERT THRUPE.

JANUARY 31.—"Californian Wines." By CHARLES P. OLDHAM.

INDIAN SECTION.

THURSDAY, JANUARY 18, at 8.30 p.m.—"The Petroleum Fields of India: their Present Condition and their Probable Future." By R. D. OLDHAM, A.R.S.M., Superintendent Geological Survey of India. SIR CHARLES EDWARD BERNARD, K.C.S.I., will preside. This meeting will be held at the Imperial Institute, S.W.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on Tuesdays, at Half-past Four or Eight o'clock:—

JANUARY 23.—"Morocco." By Captain ROLLESTON.

APPLIED ART SECTION.

The meetings of this Section will take place on Tuesdays, at Eight o'clock.

JANUARY 30.—"The Adam Architecture in London." By PERCY FITZGERALD, M.A. Colonel ROBERT W. EDIS, F.S.A., will preside.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

PROFESSOR FRANK CLOWES, D.Sc., "The Detection and Measurement of Inflammable Gas and Vapour in the Air." Four Lectures. January 22, 29; February 5, 12.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 8...Chemical Industry (London Section), Burlington-house, W., 8 p.m. Discussion on Report of Patent-law Committee.

Surveyors, 12, Great George-street, S.W., 8 p.m.

Mr. E. J. Harper, "Trade Claims."

British Architects, 9, Conduit-street, W., 8 p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m.

Rev. Dr. Dallenger, "The Pond and its Peoples: a Modern Study of Minute Life and Beauty."

TUESDAY, JAN. 9...Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lectures.) Prof. Dewar, "Air—Gaseous and Liquid." (Lecture VI.)

Medical and Chirurgial, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Robert E. Commans, "The Concentration and Sizing of Crushed Minerals."

Photographic, 50, Great Russell-street, W.C., 8 p.m.

1. Captain M. H. Hayes, "Equine Photography."

2. A Demonstration of the Air-brush, by Mr. C. L. Burdick, of Chicago.

Anthropological, 3, Hanover-square, W., 8½ p.m.

1. Prof. Basil Hall Chamberlain, "Two Funeral Urns from Loochoo." 2. Lieutenant Boyle T. Somerville, R.N., "Ethnological Notes on the New Hebrides." 3. Lionel Decle, "The Arungo and Marombo Ceremonies among the Tshinyai, and other Notes."

Colonial Inst., Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Miss Flora L. Shaw, "The Australian Outlook."

WEDNESDAY, JAN. 10...SOCIETY OF ARTS, John-street, Adelphi, W.C., 7 p.m. (Juvenile Lectures.) Prof. W. Gardiner, "Plants—their foes and defences." (Lecture II.)

Sanitary Institute, Parkes Museum of Hygiene, 74A, Margaret-street, W., 8 p.m. Dr. R. Thorne-Thorne, "Diphtheria: its Causes and Prevention."

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

THURSDAY, JAN. 11...Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m.

Mr. Wyke Bayliss, "Shakespeare, in Relation to his Contemporaries on the Fine Arts."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Inaugural Address by the President, Mr. Alex. Siemens.

Mathematical, 22, Albemarle-street, W., 8 p.m.

FRIDAY, JAN. 12...Astronomical, Burlington-house, 8 p.m.

Philological, University College, W.C., 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

SATURDAY, JAN. 13...Botanic, Inner-circle, Regent's-park, N.W., 3¼ p.m.

CORRECTION.—Page 102, col. 1, line 10, *for* high, *read* light.

Journal of the Society of Arts.

No. 2,147. VOL. XLII.

FRIDAY, JANUARY 12, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

JUVENILE LECTURES.

Mr. WALTER GARDINER, M.A., F.R.S., delivered the second of his course of Juvenile Lectures on "Plants: their Foes and Defences," on Wednesday evening, the 10th inst. He continued his remarks on the various protective agencies, and pointed out how great were the disadvantages that plants laboured under in respect of their fixture of position. In this unfavourable condition they were harassed by insects, and from these they were unable to escape. Ants were subsidised by the plants to protect them from other insects. Honey was produced for the sustenance of the ants, and a procession of these insects patrolled the plants for their protection. Many plants were so provided, but while honey was produced for the benefit of the ants, the flowers were protected from them by hairs covered with resin. The Central American acacia is protected by hollow thorns, in which the ants find a home. The ants drink the honey, and in return, clear off other insects from the plant, which could not live without their protection. Plants have two great objects of care, one to protect themselves, and the other to provide for their offspring. In the case of the Palm of India, when the flower arrives the leaves die, so that the last act of the tree is to provide for its offspring.

In some plants the number of seeds was enormous, and the loss of some of these was of little consequence; but in those instances where the number of seeds was few, special provision was made by the plant for sowing them. In the case of the sedge, the fruit was provided with a strong hook; and the birds that came to drink hooked off the fruit in their feathers and carried them many miles away. By such means as these the evil of the fixed position of the plants was obviated, and the

seed was disseminated over large tracts of country.

Instances of mimicry were exhibited, and further allusion was made to the constant fight between the plants and the animals. As an instance of this the canary seed, which has a specially hard shell, was referred to. No bird but the black cockatoo can crack this nut, but that bird is provided with a strong bill capable of dealing with it.

One of the most important agencies for the dissemination of seeds was the wind, and specimens of winged and plumed seeds were shown. These feathery objects only escape when the air is dry, for they shut up in the wet and open in the dry. In conclusion, the lecturer exhibited the movement of these seeds by bringing down from the roof of the meeting-room the beautiful seeds of the tropical cucumber.

A hearty vote of thanks to the lecturer was passed, on the motion of the CHAIRMAN.

Proceedings of the Society.

CANTOR LECTURES.

THE ART OF BOOK AND NEWSPAPER ILLUSTRATION.

BY HENRY BLACKBURN.

Lecture III.—Delivered December 11, 1893.

THE AUTHOR.

His part in the illustration of books—His handwriting—The decorative page—Examples of illustration: archaic, decorative, topical—The Book of the Past—The Book of the Future.

We come now to the consideration of a class of illustrations in which the artist of the future will have to come more into personal contact with the author than he has been in the habit of doing, and wheret he distinction I referred to in the first lecture between illustrations which are to be (1) records of facts and (2) works of art should be more clearly drawn.

Here we ask for the active co-operation of the author. The far-reaching spread of education—especially technical art education—is tending to bring together, as they were never brought before in this century, the author and the illustrator. The author of a book will give more attention to the appearance of his pages, to the decorative character of type and ornament; whilst the average artist will be better educated from a literary point of view, and, to

use a French word for which there is no equivalent, more *en rapport* with the author. By means of the cheap processes for reproducing any lines to print with the letterpress in the pages of a book, the author will have the opportunity of explaining himself, by his own notes, diagrams, &c., on the page which he never had before. This is illustration in the true sense of the word.

How false and imaginative many of the pretty illustrations in books, especially books of travel were, before the days of photography, every one knows. How easy it is to go astray in an illustration, without direct communication with the author of a book, is also well known.

To show how easily the cleverest artists may go astray without the aid of the author, I exemplified the other day, where the verbal description of a scene was read out carefully several times before a company of artists, whilst three were selected to draw upon blackboards (simultaneously and without seeing each other's work) the principal lines of composition as presented to their minds. Each was, in a sense, a work of art; each differed widely from the other, and all were wrong! The exhibition was highly stimulating and interesting, but the immediate object was to show how useless and absurd many illustrations are in books, *as illustrations*. If they are works of art they may be accepted as worthy decorations of a book; but, in the face of what photography is doing now, there is less and less demand for the imaginative landscape compositions which graced so many books of travel twenty years ago. As to purely imaginative illustrations, in which the mind in them plays the most important part, there is happily plenty of scope for the educated illustrator of to-day. But first as to—

THE AUTHOR.

Considering the small amount of interest which the author—whether historian, poet, essayist, man of science, or discoverer—seems to take in the production of his book, and the personal interest with which he might endow it, let me draw a picture of the average author of to-day—or yesterday; the “man of letters,” the student, who lives apart from the whirl of journalism and hand-to-mouth literature. The picture may be a little fanciful, but it is intended to be suggestive, not only to the author, but to all who are engaged in the production of books, whether “*olde style*,” or otherwise.

If there be one characteristic which should enhance the interest attaching to the expres-

sion of a writer's thoughts, it should be that his individuality, or personality so to speak, should be in some way expressed on the printed page. Chaucer, Shakespeare, Milton, Scott, Byron, Dr. Johnson, and the men of letters of the past, are, each of them, deeply interesting to us in their personality, in their costume, in their handwriting, and in whatever they have left behind them as the work of their own hands. As matters stand at present, the the high pressure of work imposed upon anyone who has something to say, is turning the picturesque figure of the “author” (as we read of him in past times) into a more or less highly-strung, pre-occupied, steam-driven “literary machine.”

Looking backward to the Victorian age (say from the end of the twentieth century), what pictures will be formed in the minds of those who come after us, of the *entourage* of the man of letters of to-day? Clothed in a degrading, characterless costume, which takes all appearance of manliness and suppleness from his figure, living in houses and in cities in which nearly everything ornate or beautiful has been stolen, borrowed, or copied from another country or period, he is found engaged in the production of books in which, as far as the mechanical parts are concerned, nearly everything is a sham.

The nineteenth century author's love for the literature of his past has led him to imitate not only the style, but the outward aspect of old books; and, by a series of frauds (to which his publisher seems to have lent himself only too readily), to produce something which appears to be what it is not.

The genuine outcome of mediæval thought and style—of patience and leisure—is treated at the end of the nineteenth century as a fashion to be imitated in books, such as are to be seen under glass cases in the British Museum. The twentieth century reader, looking back, will see few traces worth preserving, either of originality or of individuality.

The typesetter of to-day takes down a Venetian writing master's copy-book of the sixteenth century [which I will show presently on the screen] and, imitating exactly the thick downward strokes of the reed pen, forms a set of moveable type, called in printer's language “old face,” a style of letter much in vogue in 1893; but the style and character of which belongs altogether to the past. Thus, with such aids, the man of letters of to-day—living in a whirl of movement and discovery—clothes himself in the handwriting of the Venetian

scholar as deliberately as the Norwegian disguises himself in a bear skin.

The next step is to present in his book a series of so-called "engravings," which are not engravings. The advance of science in producing blocks, from photographs of steel and other intaglio plates, for the type printing press, at a small cost per square inch, is not only taking from the artistic value of the modern *édition de luxe*, but also from its personal interest and genuineness.

The next step is to manufacture rough edged, coarse-textured paper, purporting to be carefully "hand-made." The rough edge, which was a necessity when every sheet of paper was finished by hand labour, is now imitated successfully by machinery, and is handled lovingly by the book-worm of to-day, regardless of the fact that these roughened sheets can be bought by the pound in Drury-lane. The worst, and last fraud (I can call it no less) that can be referred to now is, that the clothing—the "skin of vellum"—that appropriately encloses our modern *édition de luxe* is made from pulp, rags, and other *débris*. That the gold illuminations on the cover are no longer real gold, and that the handsomely bound book, with its fair margins, cracks in half with a "bang," when first opened, are other matters connected with the discoveries of science, and the substitution of machinery for hand labour, which we owe to modern enterprise and invention. [Here reference was made to Mr. William Morris's exhibit of books, and to Mr. Cobden Sander-son's bindings.]

But, if it be impossible in these days (and, in spite of the efforts of Mr. Wm. Morris and others it seems to be impossible) to produce a genuine book in all its details, it is worth considering in what way the author can stamp it with his own individuality; also to what extent he is justified in making use of modern appliances.

How far, then, may the author be said to be responsible for the state of things just quoted? Theoretically, he is the man of taste and culture *par excellence*; he is, or should be, in most cases, the arbiter, the dictator to his publisher, the chooser of style. The book is his, and it is his business to decide what form his ideas should become concrete; the publisher aiding his judgment with experience, governing the finance, and carrying out details. How comes it then that, with the present facilities for reproducing anything that the hand can put upon paper, the latter-

day nineteenth century author is so much in the hands of others as to the appearance of his book? It is because the so-called educated man has not been taught to use his hands, as the missal-writers and authors of mediæval times taught themselves to use theirs. The modern author, who is, say, fifty years old, was born in an age of "advanced civilisation," when the only method of expression for the young was one—"pothooks and hangers." The child of ten years old, whose eye was mentally forming pictures, taking in unconsciously the facts of perspective and the like, had a pencil tied with string to his two first fingers until he had mastered the ups and downs, crosses and dashes, of modern handwriting, which has been accepted by the great, as well as the little, ones of the earth, as the best medium of communication between intelligent beings; and so, regardless of style, character, or picturesqueness, he scribbles away! * So much for our generally straggling style of penmanship. Looking at the handwriting of to-day, what wonder that a writer of any taste or feeling should hesitate to distribute his deformities through the world by means of *fac-simile* reproductions, and yet we desire to see the handwriting of our favourite author. But handwriting in our generation is so singularly mean and inexpressive; it has arrived at such a point of indistinctness and slovenliness amongst men that (it is sad to say it) refuge is now taken in the American type-writing machine.

Here it may be objected that, in the rapid movement of the world's work and thought, there is no time for considering the effect of a page, that the shorthand-writer and the type-writer (one and the same person) should be close at hand to take down what we have to say. This may be so in the merchant's or lawyer's office, the warehouse, the railway station, or the newspaper office, but, from a picturesque point of view, let us hope the day is far distant when an author of leisure (as distinct from the journalist) will filter out his ideas in this fashion. Anthony Trollope's record of the working of his own literary machine—of the number of words reeled off in a minute, in an hour, in a day—leaves an unpleasant sense of mechanism on the mind.

Bat we are told that we are shaking off our trammels, and that all these modern inventions are to set the spirit free; and so, to shorten

* It may not be generally known that in order to cover four average pages of a lady's letter, the point of the pen has had to travel over a distance of nearly one hundred feet!

our journeys on the road to knowledge, we are to have recourse to the "type-writer" and its most monotonous lines! Should we not rather reform our own handwriting, once for all. First study a system of shorthand for rapid notes, and then learn to write so clearly and distinctly, that a *fac-simile* of it would be a delight to read on the printed page.

Consider the question in all its bearings. The time has come when, for the first time in the history of the world, any lines drawn or written can be reproduced in *fac-simile*, from which thousands of copies can be printed. There is no occasion to repeat the details; once realise the fact that your handwork can be made to appear clearly on the printed page (with little more expense than type-setting), and you—the young author, student, man of letters—will give us in the future more of your interesting personality. The thoughts may flow as before, but the vessel to receive them and convey them to others, shall have its hallmark of individuality.

Thus in the future the distinction will be more clearly drawn between the work of the student on the one hand, and journalism, hack literature, and "penny dreadfuls," on the other. Type-setting and uniform printing of words by the thousand will be used as before, but the "author"—for want of a better word—the poet, and the scholar, who gives a book to the world, should free himself (as much as possible) from mechanical trammels, and boldly set to work to present himself in appropriate guise. The beautiful photographic processes which have been perfected during the last few years will *fac-simile* a page so accurately, that it is wonderful that so few of our artistic countrymen have availed themselves of them. Had such processes as those now in use in England, France, and Germany, been in existence in the time of the early engravers, there would probably have been no such thing as wood engraving, for the chroniclers and artists, from the engraver of St. Christopher to Bewick, would have hailed the new methods with delight. What we might have lost or gained artistically cannot be considered now. The question for the moment is how to rouse sufficient interest in these matters amongst authors.

Let us take the poets first. They have comparatively little to do with the outer world; but the public, rightly or wrongly, is eager to know more of their personality. They, the elder, the professional poets, live, most of them, in an atmosphere of cloistered silence,

of repose and picturesqueness, more akin to mediæval times than to railways and telegraphs. They come out to greet us in a garden of flowers, where Nature forms herself into pictures all around. Is it not a poor thing that they can record little or nothing of their surroundings pictorially; no mental impressions except in type-set words? With the exception of the late Lord Tennyson, it is difficult to think of any poet of our day whose personality is well known and cared for by the public. Modern dress, and the fear of appearing to "pose" in these advertising days, has led to the neglect of many outward things which the historian would hold dear.

The moral may well be drawn. Equip yourself in more ways than one for expression by the pen; to you who write, in times when it is impossible to be personally picturesque, remember that *anything drawn or written by your own hand may be of interest in the future*. These are things that the artist, as well as the author, may bear in mind, as in the future they will work much more in concert and consider *together* the setting-out of a page, the harmony of text and illustrations, and appropriate ornament on page and binding.

Is the "setting-out of a page" one of the lost arts, like the designing of a coin? What harmony of style do we ever see in an ordinary book? [Here reference was made to exhibits.] How many authors or illustrators of books show that they care for the "look" of a printed page? The fact is that the modern author shirks his responsibilities, following the practice of the greatest writers of our day. There are so many "facilities"—as they are called—for producing books that the author takes little interest in the matter. Mr. Ruskin, delicate draughtsman as he is known to be, has contributed little to the *ensemble*, or appearance of the pages that flow from the printing press of Mr. Allen, at Orpington. How well his books are printed you can see presently, but judged by the past a deadly monotony pervades the page; the master's noblest thoughts are printed exactly like his weakest, and are all drawn out in line together as in the making of macaroni! Mr. Hamerton, artist as well as author, is content to describe the beauty of forest trees, ferns and flowers, the variety of underwood and the like (nearly every word, in an article in the "Portfolio," referring to some picturesque form or graceful line), without indicating the varieties pictorially on the printed page. Tennyson and other poets have been content

for years to sell their song by the line, little heeding, apparently, in what guise it was given to the world; and so the monotony of uniformity pervades the pages, alike, of great and small, and a letter from a friend is now often printed by a machine! The last stage of feebleness and admission of incompetence in the matter of using our hands, which I may touch upon here, seems to have been reached in the indiscriminate use of the type-writer; for which, as a satirical writer lately remarked, "there is something to be said, as many of our scientific friends have been able to communicate their ideas in a letter, for the first time, by this means."

Let us now look at some slides, in illustration of what I have called the "decorative page," with and without pictorial illustrations.

1. Example of early Venetian writing, from a copy book of the 15th century, written with a reed pen. See the clearness of the page and its picturesqueness; also its similarity to the type letters used to day—what are called "old face"—the origin of what is known as Caslon type, and of much (good and bad) letter in modern books.

2. A beautiful example of Gothic writing and ornament, from a French illuminated manuscript in the British Museum; date 1480. Here the decorative character and general balance of the page is delightful to modern eyes.

3. *Fac-simile* of a printed page, from Polydore Vergil's "History of England," produced in Basle in 1556. The style of type is again familiar to us in books published in 1893; but the setting out of the page, the treatment of ornament (with little figures introduced, but subservient to the general effect), is not familiar, because few of us can produce a decorative page. The printer of the past had a sense of beauty, and of the fitness of things apparently denied, to all but a few, to day.

4. An illuminated printed page, 1521, with engraved borders, after designs by Holbein; figures again subordinate to the general effect.

5. Example of a page, Italian, 14th century; ornament, initial, and letters forming a brilliant and harmonious combination.

In all these pages, it will be observed, what is called "colour" in black and white is preserved throughout. Closely criticised, some of these block designs may appear crude and capable of more skilful treatment, but our object is to study the effect of a page without "illustrations," in the modern sense of the word; to see how colour and breadth is obtained

in pure line. In these and similar pages, such, for instance, as "Le Mer des Histoires," produced in Paris by Pierre le Rouge in 1488, the harmony of line-drawing with the type letters is most interesting and instructive at the present time. It may be attained in line, but never in wash drawings, reproduced by the processes.

It is in the production of the decorative page that wood engraving asserts its supremacy still, as may be seen in some beautiful books produced in England during the past year, which we will examine after the lecture. Mr. William Morris's books, which he has kindly lent us—where artist, wood-engraver, type-founder, paper maker, printer, and book-binder work under the guiding spirit (when not the actual handwork) of the author—have been fully described elsewhere. They are interesting to us rather as exotics; an attempt to reproduce the exact work of the past under modern conditions; conditions which render the price within reach only of a few. But they are at least a protest against the modern shams of which I have spoken to-night.

From an economic and practical point of view, and as a new departure in modern illustration, I would rather point to the work produced by an art school, where an educated and intelligent mind seems to have been the presiding genius; where the illustrators, whilst they are fully imbued with the spirit of the past, have taken pains to adapt their methods to modern requirements. I refer to the Birmingham Municipal School of Art. Whilst using wood engraving freely, the illustrators of Birmingham, notably Mr. Gaskin, have shown, as in the page before you, what can be done in line drawing by the relief processes, to produce colour and ornament which harmonise well with the letterpress of a book. [Slide of page from Mr. A. J. Gaskin's illustrations to "Hans Andersen's Fairy Tales."] This seems an important step in the right direction, and if the work emanating from this school were less, apparently, confined to an archaic style, to heavy outline and mediæval ornament (I speak from what I see, not knowing the school personally), there are possibilities for an extended popularity for those who have worked under its influence.

[Continuing the remarks on the modern decorative page, two slides were shown of pages designed by Mr. Walter Crane, "The White Snake" and "The Geese and the Cranes." Mr. Crane's pages were cited as excellent modern examples of style, in which harmony

of text and illustration have been considered. It was pointed out here how unsuitable steel engravings and fine wood cuts appear when in close juxtaposition with the type of a book.

Other slides were then shown on the screen, one of the most interesting being the enlargement of an American wood engraving from the October number of the *Century Magazine*; also a title page to an American edition of "She Stoops to Conquer"—design and lettering all drawn in pen and ink by Mr. Alfred Parsons, and reproduced by an intaglio process.]

Referring, further, to wood engraving, Mr. Blackburn said:—As regards wood engraving generally in the year 1893, one has only to point to this frontispiece from the *Century Magazine*, and to continual arrivals of new illustrations from the other side of the Atlantic, to prove that wood engraving as an art, in qualities of delicacy, tone, and colour, has never been excelled. The artistic excellence of American engraving is, as we all know, a matter of capital and energy; the enormous circulation of their magazines enabling the proprietors to give wood engravers the best education possible (in Paris and other capitals of Europe), placing them on a social level with the illustrator, a very important point. Another powerful factor is the excellence of American printing.* Mr. J. Comyns Carr, lecturing in this room in May, 1882, when the possibilities of process work were less understood than now, said:—

"Book illustration as an art is founded upon wood engraving, and it is to wood engraving that we must look if we are to have any revival of the kind of beauty which early printed books possess. In the mass of work now produced there is very little trace of the principles on which Holbein laboured. Instead of proceeding by the simplest means, our modern artist seems rather by preference to take the most difficult and complex way of expressing himself. A wood engraving, it is not unjust to say, has become scarcely distinguishable from a steel engraving, excepting by its inferiority."

This was said more than eleven years ago, and referred especially to the elaborate and beautiful wood engravings which came from America. Speaking now, in 1893, we are bound to say that the art of wood engraving has not pro-

gressed in England in the last ten years, and that the simplicity and individuality of such work as that of Bewick, is rarely to be seen in the pages of our printed books. With the fine examples by Mr. W. Biscombe Gardner, and other engravers (which we shall see after the lecture), I must leave this part of the subject. Time only prevents me from mentioning other books published in England in 1893, in which artist, engraver, and printer have worked well together.

In conclusion then, let me say that every one who cultivates a taste for artistic beauty in books, be he author, artist, or artificer, may do something towards relieving the monotony and confusion in style, which pervades the outward aspect of so many books. It is a far cry from the work of the missal writer in a monastery to the pages of a modern book, but the taste and feeling which was shown in the 15th and 16th century in the production of books, exists in the 19th (as we know), but under the difficult conditions of our times.

Many years ago the question was asked in the *Athenæum*, "Why is not drawing for the press taught in our Government schools of art?" I think the principal reasons why the art of illustration by the processes is not generally taught in art schools are (1) drawing for reproduction requires more personal teaching than is possible in public schools; (2) the art masters throughout the country (with very few exceptions) do not understand the new processes, which is not to be wondered at.

It is not the fault of the masters in our schools of art throughout the country that students are taught in most cases as if they were to become painters, when the only possible career for the majority is that of illustration, or design. The masters are, for the most part, well and worthily occupied in giving good groundwork of knowledge to every student, as to line drawing. There is no question that the best preparation for this work (*pace* the paragraph from the *Athenæum*) is the *best general art teaching that can be obtained*. The student must have drawn from the antique and from life; he must have learned the elements of composition and design; have studied from nature the relative values of light and shade, aerial perspective and the like: in short, have followed the routine study for a painter whose first aim should be to be a master of monochrome.

In the more technical parts which the young illustrator by process will require to know, he will need more personal help than is easily

* Here it should be remarked that the artist who draws for the processes in this country must not expect (excepting in very exceptional cases) to have his work reproduced and printed, as in America. He must learn to adapt himself to other conditions; this, apparently, few artists or teachers seem to realise.

obtainable in classes in schools of art. He will have a multitude of questions to ask "somebody" as to the reasons for what he is doing; for what style of process work he is by touch and temperament best fitted, and so on. All this has to be considered if we are to keep a good standard of art teaching for illustration.

In the book of the future we hope to see less of the "lath and plaster" style of illustration, as produced from careless wash drawings by process; fewer of the blots upon the page, which the modern reader seems to take as a matter of course. In books, as in periodicals, the illustrator will have to divest himself, as far as possible, of that tendency to scratchiness and exaggeration that injures so many process illustrations, as pointed out in the first lecture. In short, he must be more careful, and give more thought to the meaning of his lines, to the adequate expression of textures, and the like. There is no reason why the texture of a man's coat should look like straw, or the background to a figure have the appearance of fireworks. No amount of ability on the part of the artist will make these things tolerable in the near future.

In "the book of the future," the author may do more than he has ever done, as I have already suggested; a volume of instances might be given where a writer's meaning could be more clearly expressed pictorially than verbally. The subject is not half ventilated yet, nor can I touch upon it further to-night; the day is not far distant when the power of the hand of the author will be tested to the utmost, and lines of all kinds will appear in the text. There is really no limit to what may be done with modern appliances, if only the idea is seized with intelligence; the journalist of the future will also aid unconsciously in the formation of a new language, which every nation can understand.

In conclusion, Mr. Blackburn said:—In thus considering the education of the illustrator of to-day, I need hardly remind you of several modern books which come greatly to his aid. Three of the first importance are—"The Graphic Arts," by P. G. Hamerton (London: Macmillan and Co.); "Pen and Pencil Artists," by Joseph Pennell (London: Macmillan and Co.); "English Pen Artists of To-day," by J. G. Harper (London: Rivington, Percival and Co.)

The value and comprehensive character of Mr. Hamerton's book is well known, but it reaches into branches of the art of illustration

far beyond the scope of these lectures. Of the second, it may be said that Mr. Joseph Pennell's book is most valuable to students of "black and white," with the caution that many of the illustrations in it were *not drawn for reproduction*, and would not reproduce well by the processes we are considering. The third volume seems more practical for technical purposes.

It is to be regretted that these books are so costly as to be out of the reach of most of us; but they can be seen to advantage in the library of the South Kensington Museum.

Mr. Hamerton's "Drawing and Engraving, a brief Exposition of Technical Principles and Practice" (London: Adam and Charles Black, 1892), and "The Photographic Reproduction of Drawings," by Col. J. Waterhouse (London: Kegan, Paul, and Co., 1890), are both portable and useful books, full of technical information. Sir Henry Trueman Wood's "Modern Methods of Illustrating Books," is also an excellent little manual, but its date is 1886.

[Here reference was made to the various exhibits of books and frames, lent by Messrs. Macmillan and Co., Mr. Fisher Unwin, Messrs. Seeley and Co., Messrs. Longmans and Co., The Leadenhall Press, Mr. George Allen, Messrs. Morris and Co., 449, Oxford-street, Messrs. Field and Tuer, Messrs. Rivington, Percival, and Co., Mr. Elkin Mathews, of Vigo-street, Mr. Ralph Nevill's "Old Cottage and Domestic Architecture in South-west Surrey, 1892," and others.

On the walls were drawings by Mr. John Ruskin, lent by Mr. George Allen, original drawings by various illustrators, also specimens of wood-engraving, and other processes.]

Miscellaneous.

PROPOSED SYSTEM FOR PASTEURIZING THE MULTIVOLTINE SILKWORMS OF THE TROPICS.

BY LEONARD WRAY, JUN., F.Z.S.,

Curator Perak Government Museum and State Geologist.

It is well known to all who take an interest in silk culture that this important industry, which is carried on extensively in Southern Europe, was, some years back, nearly ruined by the spread of the disease called pebrine. This disease is due to the presence of a bacterium, which is thus described by Mr. E. M.

Crookshank in his "Practical Bacteriology":— "*Panhistophyon ovatum*, Lebert. (*Nosema bombycis*, *micrococcus ovatus*, *corpuscles du ver à soie*). Shining oval cocci, 2 to 3 μ long, 2 μ wide, singly and in pairs, or masses; or rods, 2.5 μ thick, and twice as long. They multiply by subdivision. They were experimentally proved to be the cause of *pebrine*, *gattine*, *maladie des corpuscles*, or *fleck-sucht*; and were discovered in the organs of diseased silkworms, as well as in the pupæ, moths, and eggs."

The last word of this description indicates how it is that this disease is so destructive, for, as it is found in the eggs, it is, of course, hereditary, and passes directly from one generation to the next.

M. Pasteur, after long and careful study of the disease and the micro-organism which causes it, suggested means whereby it was possible to detect the diseased eggs, and so ensure the health of the subsequent brood; and it is not too much to say that this investigation was the means of saving the sericulture of Europe from the total extinction that threatened it.

The Pasteur system, as carried out in the South of France and Italy, is, briefly, this: Each female silkworm moth is placed in a little muslin bag to lay her eggs. After they are laid, the moth is put into a small glass mortar and crushed with a glass pestle, a few drops of water are added, and a droplet of the water is then transferred to a glass slide, covered with a cover-glass, and examined under a microscope. The bacterium, being large, oval, and shining, is very readily detected with a power of about 600 diameters, and, if any corpuscles are discovered, it is certain that the moth was diseased, and the chances are that the eggs will be diseased also. Therefore, whenever the moth is found to be affected, her eggs are at once destroyed; while, on the other hand, if she is seen to have been free from disease, her eggs are kept and used for breeding purposes. There are several large firms which do nothing but produce these selected eggs for sale to the cultivators. One of these establishments employs over 300 microscopists to examine the female moths.

The spread of pebrine has been very great of late years in India, China, and Japan, and the authorities have been trying for some seven or eight years past to introduce the Pasteur system into India, but, hitherto, without any appreciable success. The reasons for this are very simple. The worm grown in Europe is an annual, and between the laying of the eggs and the hatching many months elapse, during which the process of selection can go on. For it is not necessary that the moths be examined at once; they may be kept a long time in a dry state before being placed under the microscope. Now, in India and other tropical countries the worm which is grown is what is called a "multivoltine"—that is, it has many generations in a year, and the time which elapses between the laying of the eggs and the hatching is only from six to seven days,

thus limiting the time during which the selection can be carried on to about five days, if the eggs are to be sold as eggs.

The large staff of microscopists which would have to be employed to turn out any considerable quantity of eggs would be so expensive to maintain, that, from a commercial point of view, the system would be absolutely impossible. In addition to this, it appears that, to eradicate the disease from these tropical worms, one selection is quite insufficient. The system, therefore, besides being very costly, produces eggs which are by no means to be relied on as being free from disease.

In November of the year 1889 silk culture was started by some Chinese, in the State of Perak in the Malayan Peninsula. Pebrine quickly made its appearance and caused serious losses in 1891, and in February, 1892, the enterprise had to be abandoned owing to the ravages of the disease. Shortly after the sickness amongst the worms showed itself, I tried to apply the Pasteur system to them, and arrived at the conclusion above stated, after about a year's work. In November, 1891, I began another series of experiments, which have led to results which appear to show, that there is a way of applying the Pasteur system to the multivoltine silkworms of the tropics both economically and effectively.

My experiment was begun with some cocoons procured from one of the Chinese cultivators, and on a microscopical examination of the female moths, after they had laid their eggs, it was found that they were all diseased. The eggs of the least infected moths were taken and hatched, and the young worms were placed in little china cups, four worms in each. The cups were stood on a table, and they and the table were frequently disinfected, during the lifetime of the worms, with a soap solution containing five per cent. of carbolic acid. Before use the house was also thoroughly disinfected by fumigation with sulphur. When any diseased worms were noticed they were at once removed and destroyed. By these means about eighty cocoons were produced, a fair proportion of the moths from which, on microscopic examination, were found to be healthy. By continuing the same procedure for three generations the pebrine was entirely eradicated from the stock, and a healthy breed established. After this, isolation in the cups was no longer necessary.

Up to this stage the experiment proved that microscopical selection coupled with isolation and rigid sanitary precautions would produce in a breed, every individual of which was infected with pebrine, a perfectly healthy race in the course of three generations, or in about four months time.

Continuing the series of experiments it was proved that eggs laid of these healthy moths, when reared under conditions nearly similar to those which are maintained in the wards of a modern hospital, did not contract the disease during several successive generations; without either microscopic or any other selection. For nearly two years this series of experi-

ments was carried on, and it is believed that the two facts above stated have been, during that time, placed beyond doubt.

To recapitulate, these are firstly, that a healthy race may be produced in these generations from a highly diseased one; and secondly, that having once procured a healthy race, simple sanitary precautions are sufficient to guard it from contagion for several successive generations. On these two easily understood and proved facts is based the system here advocated.

This system I will now endeavour shortly to explain. A breed of, say 3,000 worms, which, for convenience, may be called "firsts," would be produced in the manner already described, and maintained pure by being microscopically selected at every brood. One microscopist could examine all the female moths of each brood of this number of worms, between the laying and hatching of the eggs. A certain number of the eggs from the best cocoons would be put aside for the next generation of "firsts," and the remaining eggs would be reared in separate houses, in which strict sanitary precautions would be enforced.

This brood, which may be called "seconds," on attaining maturity would lay, but would not be subjected to microscopic selection; and it is these eggs which would be given or sold to the cultivators. They would therefore be always only once removed from the "firsts," or microscopically selected eggs.

If 1,200 female moths, out of the 3,000 above-mentioned, were passed at an inspection of "firsts" they would yield, say 240,000, or 120,000 female "seconds"; which again would yield 24 millions of eggs for distribution. This number of worms would give $16\frac{1}{2}$ tons of "green" or fresh cocoons, and at four broods per annum, say 64 tons, as the outcome of the work of a single microscopist for a year. This is as much as one hundred microscopists could do, with multivoltine worms, if working by the ordinary method of selection as practised in Europe. In the above computation it has been assumed that out of the 355 eggs which an average moth has been found to lay, only 200, or 56 per cent., will attain maturity. This is a large margin to allow; as it has been found by experiment that, having once obtained a pure breed, the mortality amongst the "seconds" does not exceed 5 per cent.

The success of the whole system depends on guarding from external sources of contagion the generation after that which has been proved to be free from disease by microscopical examination. To do this, cleanliness, the free use of antiseptics, isolation, and the growing of the food in a place where it will not be infested by unhealthy worms, are the main points to be attended to. The windows and all the openings of the breeding houses should be covered with wire-netting, and in a place much infested with flies all the outer doors should be double to prevent their ingress. The trays might be of zinc, and most of the other things used of the

same material. These can be instantly disinfected by plunging into a pan of boiling water, or of carbolic solution, the former for preference. The tray-stands should all be made of galvanised, or better, enamelled, iron, and the floors either cemented or asphalted. Large houses are to be avoided both for "firsts" and "seconds," as in case of the outbreak of any disease small detached houses have such self-evident advantages.

From time to time it might be necessary to introduce fresh blood into the breed, and for this purpose the fresh worms should be microscopically selected for four or five generations before mixing them with the original "firsts," being kept during the probation in a house isolated as far as practicable from all the others. It may be again mentioned that I have found a single selection, never mind how carefully it is done, is insufficient to eliminate pebrine from a race of these tropical worms. Therefore it follows that it is useless to attempt to produce "seconds" until the "firsts" have been thoroughly purged of all traces of disease, by repeated selections.

In an establishment such as is here outlined, the microscopist would be the only highly paid man. All the other work could, after a little time, be done by ordinary coolies, so that the cost of maintenance would be comparatively unimportant, and the eggs could be consequently supplied at a very low price. An establishment employing three or four microscopists would suffice for the supply of a large silk-producing district. The distribution could either be made of the eggs, or of the cocoons of the "seconds"; so that there would be plenty of time to send them long distances. This is a matter of considerable moment, as it is of the utmost importance that the tending establishment should be as remote as possible from the cultivators. Every mile that intervenes decreases immensely the chances of the appearance of diseases of all kinds amongst the worms, and of the presence of flies and other insect pests that attack them.

I venture to predict that this system, if carried out in the way here indicated, will do for the multivoltine silkworms of the tropics what the system practised in Europe has done for the annual silkworms of temperate climates.

FRANKLIN SOCIETY MEDALS AND PREMIUMS.

The Frankland Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts may grant, or recommend the grant of, certain medals for meritorious discoveries and inventions which contribute to the promotion of the arts and manufactures. The character and conditions of these awards are briefly stated in the following:—

The Elliott Cresson Medal, founded in 1848 by the gift of the late Elliott Cresson. This medal is of gold, and, by the terms of the deed of trust, may be

granted for some discovery in the arts and sciences, or for the invention or improvement of some useful machine, or for some new process, or combination of materials in manufactures, or for ingenuity, skill, or perfection in workmanship.

The John Scott Legacy Premium and Medal (twenty dollars and a medal of bronze), awarded by the city of Philadelphia. This medal was founded in 1816, by John Scott, a merchant of Edinburgh, Scotland, who bequeathed to the city of Philadelphia a considerable sum of money, the interest of which should be devoted to rewarding ingenious men and women who make useful inventions. The premium is not to exceed twenty dollars, and the medal is to be of copper, and inscribed "To the most deserving." The control of the Scott Legacy Premium and Medal (by Act of the Ordinance of Councils in 1869) passed to the Board of Directors of City Trusts, and has been referred by the Board to its Committee on Minor Trusts, and that committee has resolved that it will receive favourably the name of any person whom the Franklin Institute may from time to time report to the Committee on Minor Trusts as worthy to receive the Scott Legacy Premium and Medal.

The Edward Longstreth Medal of Merit, founded in 1889, by Edward Longstreth, machinist, and late member of the Baldwin Locomotive Works. This medal is of silver, and may be awarded for useful invention, important discovery, and meritorious work in, or contributions to, science or the industrial arts.

Full directions as to the manner and form in which applications for the investigation of inventions and discoveries should properly be made, will be sent to interested parties on application to William H. Wahl, Secretary, Franklin Institute, Philadelphia, Pa., U.S.A.

PRIZES FOR STREET CABS.

A prize of £7 is offered by Mr. Thrupp for the best design for an open cab on four wheels, to carry two or more passengers and light luggage, by day or night, and in any weather. The cab to have advantages similar to those found in a Hansom cab, the hood to fall, however, and the driver to be in front. A further sum of £7 will be given among competitors sending meritorious designs. Further prizes, to £10 total, will be given to draughtsmen for good working drawings of existing four-wheeled open cabs, such as are in use in England or any part of the world. Special consideration will be given to such cabs as give shelter against bad weather. These competitions are open to all, whether British or foreign, draughtsmen, masters, or workmen. The designs are to be on the scale of one inch to the foot on paper, mounted on millboard or drawn on stiff cardboard, of the uniform size of 22 by 26 inches. Each design to be a side elevation and half-back, with a half-plan on the lower part of the paper. The designs are to be working drawings, in stout black ink outline, not

shaded or coloured. The designs are to be sent free, before or on March 1st, 1894, by the permission of the Council of the Society of Arts, to their rooms in John-street, Adelphi, London, W.C., and addressed for the "Prize Cab Exhibition." Each design to bear a motto or mark on the centre of the top of the paper, and also on the outside of the package. A letter, with the same motto outside, and containing the real name and address, is to be sent at the same time to Mr. Thrupp, at 11, Maida-vale, London, W., who will answer any fair question as to the competition. The address and name of any competitor will be kept secret, if he so desires in his letter. The drawings will be exhibited in March, in or near Long-acre, and the general public and cab proprietors will be apprised of it by advertisement.

As the object of the competition is to guide and assist cab builders and proprietors to bring forward improved cabs for the use and advantages of the general public, it is suggested that competitors should bear in mind the importance of considering in their designs—Ease in motion, durability, simplicity in construction, economy in manufacture, and lightness of draught of a cab. The size of a vehicle intended for London use and free passage through the streets should be moderate.

Correspondence.

CARRIAGEWAY PAVEMENTS.

Mr. JAMES DONALD writes:—I have just read the adjourned discussion on Mr. Lewis H. Isaacs's paper, recently delivered at the Society of Arts, and having had many years experience of asphalt, both natural and artificial, perhaps you will allow me to give the result of one of many experiments which were made, with the view to find what was the cause of the great difference in wearing power of those two asphalts. Mr. G. F. Deacon seems to think it is owing to imperfect combination of the ingredients, in the case of the artificial article. I am not of that opinion, but believe it is solely due to the nature of the hydrocarbons. In the one case this is formed with a high heat and rapidly in the gas retort, while the other had its existence under very different conditions, probably with a very low heat, and under enormous pressure; at all events, the hydrocarbons of the two are quite different. To prove this, I made the following experiment. I treated British pitch and natural asphalt separately with benzol, and filtered, so as to remove, in the one case, the solid carbonaceous matter, and in the other, the earthy ingredients. The solutions were then evaporated, each to the consistence of varnish, and applied with a brush to a smooth metallic surface, and allowed to dry. When quite hard, the coating from the British pitch solution was found to be easily marked, and could even be fractured with the thumb-nail, while that of the natural asphalt could not be so marked,

but required a knife to make any impression on it. I concluded from this that the wearing property depended more upon the nature of the hydrocarbon than the earthy matters, or the manner or proportions in which they were mixed. I may say that I had previously made numerous mixtures, and in many different proportions, of earthy matters with British pitch, but none of them came up to the natural production. I found clay, dried slowly, and afterwards ground to a very fine powder, and chalk to make a very tough combination with British pitch, the distillation of which had not been carried quite so far as is usually done.

General Notes.

THE CHICAGO EXHIBITION.—A lecture on the Chicago Exhibition was delivered on Monday evening, at the Imperial Institute, by the Hon. J. J. Grinlinton, special commissioner for Ceylon at that Exhibition. Mr. Grinlinton stated that the object Ceylon had in taking part in the Exhibition was to introduce Ceylon teas into America, and in order that there should be something which the Americans had not seen before, Ceylon spent £20,000 in making a suitable exhibit, and erecting suitable buildings. The Ceylon portion of the Exhibition was very popular, and on "Chicago Day," when 800,000 persons visited the Exhibition, the Ceylon portion was attended by over 100,000. Of the whole Exhibition the lecturer spoke in the highest terms, and was loud in his praises of the unvarying courtesy he received from all the authorities in America. The only part of the Exhibition that failed was the jurors' awards, and he had already written an official letter on the subject, in which he described that department as "incapable." Neither as regarded finances nor as regarded the number of visitors was it a failure, for there was a balance of \$1,128,508 in the treasury. The lecture was illustrated by some beautiful dissolving views, showing all the principal portions of the Exhibition.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

JANUARY 17.—"White Lead Substitutes." By A. LAURIE, M.A. PROF. W. C. ROBERTS-AUSTEN, C.B., F.R.S., will preside.

JANUARY 24.—"American Carriages." By G. HERBERT THRUPP.

JANUARY 31.—"Californian Wines." By CHARLES P. OLDHAM.

INDIAN SECTION.

The meetings of February 15, March 8, April 26, and May 24, will be held at the Society of

Arts; those of January 18, February 8, and March 19, at the Imperial Institute.

THURSDAY, JANUARY 18, at 8.30 p.m.—"The Petroleum Fields of India: their Present Condition and their Probable Future." By R. D. OLDHAM, A.R.S.M., Superintendent Geological Survey of India. SIR CHARLES EDWARD BERNARD, K.C.S.I., will preside.

THURSDAY, FEBRUARY 8, at 4.30 p.m.—"Telegraphic Communication between England and India: its Present Condition and Future Development." By E. O. WALKER, C.I.E., M.I.E.E., formerly of the Government of India Telegraph Department. SIR THOMAS SUTHERLAND, K.C.M.G., M.P., will preside.

THURSDAY, FEBRUARY 15, at 4.30 p.m.—"Experiences at the Court of Afghanistan." By JOHN A. GRAY, late Surgeon to His Highness Abdul Rahman Khan, Ameer of Afghanistan.

THURSDAY, MARCH 8, at 4.30 p.m.—"The Indian Currency." By J. BARR ROBERTSON.

MONDAY, MARCH 19, at 8.30 p.m.—"Indian Railway Extension: its Relation to the Trade of India and of the United Kingdom." By JOSEPH WALTON. SIR JAMES KITSON, Bart., M.P., will preside.

THURSDAY, APRIL 26, at 4.30 p.m.—"Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh." By SIR AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieutenant-Governor of the North-West Provinces and Oudh.

THURSDAY, MAY 24, at 4.30.—"Chota Nagpore: its Mineral Wealth and its value to India." By J. F. HEWITT, late Bengal Civil Service. SIR ALEXANDER WILSON, formerly President of the Bengal Chamber of Commerce, will preside.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on Tuesdays, at Eight or Half-past Four o'clock:—

JANUARY 23.—"Morocco." By Captain ROLLESTON.

FEBRUARY 20.—"The Antwerp Exhibition, 1894." By EDOUARD SÈVE.

MARCH 6, at 4.30.—"The Industrial Resources of Russia, Siberia, and the New Railway." By E. A. CAZALET.

APRIL 17.—"Tasmania and the forthcoming Hobart International Exhibition, 1894-95." By J. F. ECHLIN.

MAY 1.—"Paraguay." By A. F. BAILLIE.

MAY 29.—"Education in Victoria." By Prof. C. H. PEARSON, M.A., LL.D.

APPLIED ART SECTION.

Tuesday Evenings, at Eight o'clock:—

JANUARY 30.—"The Adam Architecture in London." By PERCY FITZGERALD, M.A. Colone ROBERT W. EDIS, F.S.A., will preside.

FEBRUARY 13.—“Modern Development of Illustrated Journalism.” By HORACE TOWNSEND.

FEBRUARY 27.—“Goldsmiths’ Work: Past and Present.” By Mrs. PHILIP NEWMAN.

MARCH 13.—

APRIL 10.—“The Evolution of Decorative Art.” By HENRY BALFOUR, M.A.

MAY 8.—“Pewter.” By J. STARKIE GARDNER.

CANTOR LECTURES.

Monday Evenings, at Eight o’clock:—

PROFESSOR FRANK CLOWES, D.Sc., “The Detection and Measurement of Inflammable Gas and Vapour in the Air.” Four Lectures.

LECTURE I.—JAN. 22.—The necessity of detecting minute proportions of fire-damp, coal-gas, and petroleum vapour in air—Early tests for fire-damp with the naked candle flame—Later tests with the Davy lamp—Improvements in tests with oil flame of safety-lamp—Use of benzoline flame in safety-lamp.

LECTURE II.—JAN. 29.—Attempts to utilise diffusion and other physical processes—Living’s electrical indicator—Apparatus depending upon the alteration of volume caused by burning the gas—Apparatus depending on the measurement of volume of gas required to bring the mixture to the ignition point.

LECTURE III.—FEB. 5.—Employment of a large alcohol flame in a special lamp—Recent modifications—Application of a standard hydrogen flame in an ordinary illuminating safety-lamp—Attempts to use a small alcohol flame in an ordinary safety-lamp.

LECTURE IV.—FEB. 12.—Application of the standard hydrogen flame to the detection and measurement of petroleum vapour in tanks and other spaces—The test-chamber an apparatus for observing and measuring the indications of the above testing apparatus.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 15.—Imperial Institute, South Kensington, S.W., 8½ p.m. Marquis of Lorne, “Talk on the last Ten Years.”

Cleveland Institute of Engineers, Middlesborough, 7½ p.m.

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

British Architects, 9, Conduit-street, W., 8 p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. Prof. Hull, “Eastern Discoveries Confirmatory of Scriptures.”

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. C. F. Binns, “Pottery and Porcelain.”

TUESDAY, JAN. 16.—North-East Coast Institute of Engineers and Shipbuilders, Durham College of Science, Newcastle-on-Tyne, 8 p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. Charles Stewart, “Locomotion and Fixation in Plants and Animals.” (Lecture I.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Mr. Robert E. Comman’s paper, “The Concentration and Sizing of Crushed Minerals.”

Statistical, Geological Museum, Jermyn street, S.W., 7½ p.m. Mr. Reginald H. Hooker, “Modes of Census-taking in the British Dominions.”

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1.

Professor W. N. Parker, “Some Points in the Structure of the Young of *Echidna aculeata*.” 2. Mr. Ronald Trimmen, “A Collection of Butterflies made in Manica, Tropical South-East Africa, by Mr. F. C. Selous, in the year 1892.” 3. Dr. A. B. Meyer, “Remarks on *Cercopithecus wolfi*.”

Asiatic, 22, Albemarle-street, W., 4 p.m.

WEDNESDAY, JAN. 17.—SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. A. Laurie, M.A., “White-Lead Substitutes.”

Meteorological, 25, Great George-street, S.W., 8 p.m. 1. Annual General Meeting. 2. Address by the President (Dr. C. Theodore Williams), “The Climate of Southern California.”

Microscopical, 20, Hanover-square, W., 8 p.m. Annual General Meeting. Address by the President, Mr. A. D. Michael.

Entomological, 11, Chandos street, W., 7 p.m. Address by the President, Mr. Henry J. Elwes.

Archæological Association, 32, Sackville-street, W., 8 p.m.

Patent Agents, 19, Southampton-buildings, W.C., 7½ p.m. 1. Discussion on Mr. Fell’s paper, “Anomalies of the Swiss Patent-law Administration.” 2. Mr. F. Walsh, “The Trade Marks Amendment Act, New South Wales.”

THURSDAY, JAN. 18.—SOCIETY OF ARTS, John-street, Adelphi, W.C. 8½ p.m. Mr. R. D. Oldham, “The Petroleum Fields of India: their Present Condition and their Probable Future.” (This meeting will be held at the Imperial Institute, S.W.)

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. Rev. Geo. Henslow, “The Origin of the Structural Peculiarities of Climbing Stems by Self-adaptation in Response to External Mechanical Forces.”

Chemical, Burlington-house, W., 8 p.m. 1. Prof. Ramsay and Miss Emily Aston, “The Molecular Formulae of some Liquids as determined by their Molecular Surface.” (Energy I) 2. Contributions to our Knowledge of the Aconite Alkaloids:—VIII.—Prof. Dunstan and Mr. E. F. Harrison, “Picroconitine.” IX.—Prof. Dunstan and Mr. F. H. Carr, “The Action of Heat on Aconitine.” X.—Prof. Dunstan and Mr. F. H. Carr, “Further Observations on the Conversion of Aconitine into Isaconitine.” 3. Drs. Mason and Winder, “The Interaction of Benzylamine and Ethyl Chloracetate.”

London Institution, Finsbury-circus, E.C., 6 p.m. Prof. C. Stewart, “Some Curiosities of Natural History.” (Lecture I.)

Royal Institution, Albemarle-street, W., 8½ p.m. Rev. Canon Ainger, “The Life and Genius of Swift.”

Historical, 20, Hanover-square, W., 8½ p.m. Major Martin Hume, “Antonio Perez in Exile.”

Numismatic, 22, Albemarle-street, W., 7 p.m.

Camera Club, Charing-cross-road, W.C., 8 p.m. Paper by Mr. W. I. Chadwick.

FRIDAY, JAN. 19.—Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Prof. Dewar, “The Scientific Uses of Liquid Air.”

Civil Engineers, 25, Great George-street, S.W., 7½ p.m. (Students’ Meeting.) Mr. W. G. Wales, “Discharging and Storing Grain.”

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, JAN. 20.—Royal Institution, Albemarle-street, W., 3 p.m. Prof. W. H. Cummings, “English School of Musical Composition.” (Lecture I.)

Journal of the Society of Arts.

No. 2,148. VOL. XLII.

FRIDAY, JANUARY 19, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

SWINEY PRIZE.

The adjudicators under the will of the late Dr. Swiney are summoned to meet at the House of the Society of Arts, John-street, Adelphi, London, on Monday, the 22nd January, 1894, at 4.15 p.m., to make the award in conformity with the terms of the bequest contained in the will of the testator.

By order,

HENRY TRUEMAN WOOD,

Secretary.

Proceedings of the Society.

SEVENTH ORDINARY MEETING.

Wednesday, January 17, 1894; Prof. W. C. ROBERTS-AUSTEN, C.B., F.R.S., Member of the Council, in the chair

The following candidates were proposed for election as members of the Society:—

Barber, Amzi Lorenzo, Belmont, Washington, U.S.A., and care of J. W. Privité, 2, Crosby-square, E.C.

Barry, John, M.P., Kirkcaldy, Fifeshire.

Bayard, Francis Campbell, 2, Cloisters, Temple, E.C., and Wallington, Surrey.

Bloomer, Thomas, 36, Springfield-road, St. John's-wood, N.W.

Bright, Fred E., Cleveland, Ohio, U.S.A., and Hotel Victoria, W.C.

Caldwell, William, Murray-street, Paisley.

Holmes, George Edward, London-road, Derby.

Jackson, Edward Francis, 49, Rathbone-place, W.

John, W. Goscombe, 34, Finchley-road, St. John's-wood, N.W.

Laidlay, William J., B.A., LL.D., 50, Circus-road, St. John's-wood, N.W.

Lansdown, George Arthur, 5, Warwick-street, Charing-cross, S.W., and The Briars, Wimbledon.

May, Francis John Charles, 25, Compton-avenue, Brighton.

Norman, James Noel, 34, Great George-street, S.W.
Payne, R. Horne, 1, Chapel-place South, Mayfair, W.

Peele, Edmund Cresswell, Cyngfeld, Shrewsbury
Rickett, J. Compton, King's-cross, W.C.

Roberts, George, 379, Bramall-lane, Sheffield.

Slocombe, Fred, Fair View, Holder's-hill, Hendon, N.W.

Startin, James, M.B., 18, Harley-street, Cavendish-square, W.

The following candidates were balloted for and duly elected members of the Society:—

Baker, William King, Gaspereau, Cumberland-park, Acton, W.

Banks, Walter, Maisonette, Goldhawk-road, W.

Burchett, Arthur, 28, Willoughby-road, Hampstead, N.W.

Eastes, James Smith, Fairlawn, Ashford, Kent.

Gregor, Karl, 17, Gordon-street, Islington, N.

Haig, Axel Herman, Grayshurst, Grayswood-hill, Haslemere, Surrey.

Holiday, Henry, Oak Tree-house, Hampstead, N.W.

Hopkins, Herbert W., 13, Harrington - gardens, S.W.

Howard, Frank, The Chilterns, Wallingford, Berks.

Hunt, Alfred W., 10, Tor-gardens, Campden-hill, W.

Orr, Robert, 8, Great Western-terrace, Glasgow, and West Quarter, Falkirk.

Winter, W. W., Midland-road, Derby.

The paper read was—

WHITE-LEAD SUBSTITUTES.

By A. P. LAURIE, M.A.

The question of how far white-lead can be replaced, as a pigment, by other white paints, is attracting a good deal of attention at present, on account of a desire on the part of the public to obtain an article which will not entail the suffering from lead poisoning which accompanies the manufacture of the ordinary pigment. This interest has been especially excited by the publication of Dr. Arlidge's work on "The Diseases of Occupations;" by Dr. Oliver's recent work on "Lead-Poisoning;" and by the "Report of the Home-office Committee on White-lead Manufactures." The subject is one in which I have taken considerable interest, and have made a few experiments, which I propose to lay before you to-night.

As far as I am aware, there are only two substances at present manufactured which can be regarded as white-lead substitutes—sulphate of lead and oxide of zinc. Sulphate of barium has hardly any covering power, and sulphide of zinc, though remarkable for covering power, has not proved, I am given to understand, a

durable pigment, and therefore need not be considered. I have not, however, myself experimented on sulphide of zinc, and would gladly do so with samples from a reliable maker.

Oxide of zinc has already obtained an assured position, and is used to some extent in this country, and largely, I believe, in France and in Japan. Its properties as a pigment are fairly well known. It is deficient in covering power, but is remarkably white, and preserves its colour in impure air.

Sulphate of lead is, I believe, at present in the market in two forms—sublimed sulphate, prepared by the Caledonia Works, Glasgow, and precipitated sulphate, ground by Freeman's patent with oxide of zinc, and sold as Freeman's white. The sublimed sulphate is prepared directly from galena. More than one patent for doing this has been taken out, but I believe it is now only being made by the Glasgow White-lead Company, according to Mr. Hannay's patents. Sulphate of lead prepared by sublimation has much more covering power and is much denser than precipitated sulphate. At the same time, I believe it is difficult to obtain a complete yield of sulphate from the galena, which is of a good white, and not a little grey. This difficulty may, however, have been got over recently. Freeman's sulphate is prepared by dissolving lead, which has been converted into thin flakes, in acetic acid, and precipitating with sulphuric acid. This is washed, pressed, and dried. Alone its covering power is poor. It is then ground with about 20 per cent. of oxide of zinc, and a little barium sulphate, under heavy edge-runners. The result is a pigment of much greater density and covering power than either of its constituents. There is another pigment being sold as a harmless white-lead by the Patent Lead and Zinc White Company, which is prepared in a similar way, by grinding together oxide of zinc and sulphate of barium. This process is based, I believe, on an abandoned patent by Mr. Freeman, for preparing condensed oxide of zinc, by grinding oxide of zinc under heavy edge-runners.

The following samples illustrate the reduction in bulk of the powder produced:—

1. By grinding together the zinc oxide and precipitated lead sulphate.
2. By grinding zinc oxide alone.

The reduction is very remarkable, and suggests an interesting problem in molecular physics. Mr. Freeman has supplied me with some interesting facts about the results of

grinding these substances dry under heavy edge-runners. Before grinding, the mixed oxide and sulphate weighs 120 lbs. to the cubic foot, and takes 12 lbs. of oil to the hundredweight. After grinding, it weighs 199 lbs. to the cubic foot, and takes 7 lbs. of oil to the hundredweight. A comparison of the properties of some of these pigments with ordinary white-lead reveal some interesting results.

In the first place, with reference to the quantities of oil required to grind these pigments,

One cwt. of	Takes lbs. of oil.
White-lead (stack process)	9
White-lead (precipitated).....	12
The Glasgow lead sulphate	12
Zinc oxide	25
Zinc oxide (condensed).....	16
Freeman's white	7

It will be noticed that, in the quantity of oil required, these white-lead substitutes compare well with white-lead, some taking a little more and some a little less, except oxide of zinc, which takes a very large quantity.

In the second place, with reference to their susceptibility to impure air.

Here all these substitutes have a distinct advantage over white-lead, for the zinc oxide is quite unaffected, and the sulphate is very slightly affected, unless the gas is in very large quantities, and the paint wet. This panel shows distinctly the difference between white-lead and Freeman's white in this respect. It was exposed to sulphuretted hydrogen some time ago, and the white lead has to some extent recovered, being almost black at first.

It is a matter of surprise that these whites are not universally used in place of white-lead for internal work in London, where white-lead discolours so quickly. I am sure the general public would insist upon it if they knew how much it would save them in cost of painting.

The most important question is covering power. Oxide of zinc, prepared in the usual way, is of course distinctly inferior to white-lead, but I could not find any proof that special preparations of lead sulphate and zinc oxide were also deficient. In fact Prof. Church, in his book on "Pigments," distinctly states that Freeman's white has about the same covering power as white-lead. I tested the covering power of these pigments in the following way.

The outside of my laboratory is covered with weather boarding, which has had two or three coats of white-lead. I selected a certain

number of boards and painted black strips down them at equal distances apart, so as to count the surface into alternate black and white strips 3 inches broad. Each board was 6 inches broad, and I covered 10 feet in this way, so that each board represented a surface of 5 square feet. I next took equal weights of the best stack lead, of the Glasgow sulphate, and of Freeman's white, as sent out ground in oil by their respective makers.

I next employed a skilled housepainter, who added thinning, made of equal parts of oil and turps. He added the oil and turps until satisfied with the consistency of the paint. In each case 200 grammes of the paint was taken. The thinnings weighed respectively—

Grammes.		Grammes.	
White lead.....	200	Thinning	41
Freeman's white..	200	Thinning	39
Glasgow white ..	200	Thinning	45

He then painted in a coat of each paint along the board. The coats weighed respectively :—

	Freeman's white.	Glasgow white.	White- lead.
First coat	30	28	33
Second coat ..	30	28	36
Third coat	43	28	40

The black checks had very nearly disappeared from white-lead and Freeman's white.

Fourth coat 53

The checks had now disappeared completely from the Glasgow white. This last coat was laid on by an unpractised hand, and was consequently unnecessary thick. Another coat of 28 grammes would have been sufficient.

Consequently, the weight of paint used is in every case practically the same. The black checks were very faintly visible under the white-lead; slightly more so, in the case of Freeman's white; they were quite invisible for the Glasgow white.

The Glasgow sulphate, however, required four coats, each weighing less than a coat of the other pigment. The extra thinning added will not entirely account for this, and it is probably due to the extra amount of oil with which the colour is ground. Doubtless this slight defect in the sample sent to me can be overcome.

The next question of interest is the durability of the coating formed by these pigments for out-door work. I have not had sufficient time to test this question properly. I made a rough experiment, by sizing a

piece of canvas, and painting one-half with white-lead and the other half with Freeman's white, and hanging it up out of doors to flap in the wind. After six months they were both badly cracked, but one seemed no worse than the other. I presented the canvas to the White-Lead Committee. Oxide of zinc is supposed not to stand exposure so well as white-lead, and probably as it has been long in use this opinion is correct. About the durability of the whiteness there can be no question. This painting was done last June; I washed it a few days ago, and then examined it carefully. The white-lead is a dirty grey. The Glasgow white and Freeman's white have kept their colour well. The Glasgow white is covered with minute cracks, and the Freeman's white has grown slightly translucent.

Since these experiments, I have tested the covering power of condensed zinc oxide; 100 grammes of the paint took 32 grammes of thinning. Three coats weighed 25, 22, 25 grammes. The black marks were then just vanishing, so that this pigment gave the best results of all.

Next we come to the working qualities of these pigments and their consistency in oil. Their appearance in oil differs considerably from that of white-lead, being thin and stringy instead of stiff and firm; and I have no doubt this is against them. I do not find, however, that when thinned down they seem to differ appreciably from lead carbonate in ease of working. I cannot, however, pretend to speak authoritatively in this matter, but I can speak on the question of their suitability for artists' use.

I may say at once that, as sent out by the different makers, I found them quite unsuitable. An artist expects his colour to squeeze out from the tube crisp and firm, and to work with perfect ease under the brush without running. As I was anxious to introduce them to artists, I cast about for some way to get over this difficulty, and, finally, devised one which I propose shortly to describe. It is generally understood that white-lead owes its peculiar properties partly to the fact that it saponifies with the oil. This has, I am aware, been disputed by Mr. Hannay, but I have assumed the exactness of this belief in making my experiments.

Evidently, so stable a compound as lead sulphate could hardly be expected to saponify with the oil, but it seemed to me quite possible that oxide of zinc would do so. I therefore treated some oxide of zinc ground in oil with

light petroleum spirit, and found that besides dissolving the oil, the petroleum spirit had dissolved a very small quantity of zinc (·02 per cent.), which showed that a zinc soap was present, but in very minute quantities. Evidently, then, the zinc oxide was not able to decompose the glycerine fatty acid compounds. On the other hand, if zinc oxide is ground with free fatty acid it combines to form a soap (oleic or linoleic). I therefore tried the effect of adding small quantities of linoleic and oleic acid to the oil, in which the oxide of zinc was ground. I found this at once acted in a remarkable manner, converting the thin mixture into a stiff mass, closely resembling white-lead. The free fatty acid acted in a similar manner on Freeman's white, so as to convert it into a stiff mass, which completely deceived house-painters who had long been familiar with white-lead. On treating this pigment with petroleum spirit, I dissolved out a considerable quantity of zinc soap. By adding more oil, I obtained all the requirements in consistency and ease of working necessary for the artist. This method of grinding zinc oxide, which I have protected by patent, is, I believe, well worth trial on the large scale for ordinary purposes.

There is still a further matter which I have not touched on, and that is how far these pigments are non-poisonous.

Oxide of zinc is, I believe, quite harmless. Sulphate of lead is not absolutely insoluble in very weak hydrochloric acid. On three occasions I digested well-washed precipitated lead sulphate in '3 per cent. hydrochloric acid at 100° Fahr., for three hours, in this way roughly representing the action of the stomach, though, of course, with rather stronger acid (the hydrochloric acid in the stomach is about ·02). In each case I digested 1 gramme with 50 cc. of the '3 per cent. hydrochloric acid. I found—

- | | | |
|-----|-------|------------------------------|
| (1) | ·0072 | grammes of lead in solution. |
| (2) | ·0121 | " " |
| (3) | ·0090 | " " |

·0283 giving a mean = ·0094

of lead dissolved in each case, showing that about one per cent. is dissolved under these conditions. Probably therefore sulphate of lead is slightly soluble in the stomach, and therefore to some extent poisonous. I do not, however, believe that, under ordinary conditions of manufacture or use, lead sulphate would produce lead poisoning, nor would one or two doses swallowed do any harm.

Nothing but repeated doses in considerable quantity would probably produce lead poisoning, and this does not happen under ordinary circumstances.

In conclusion, I should like to point out that this question of white-lead substitutes is part of a very large subject, namely, how we can render our various industrial processes harmless to those employed. For this century, our scientific knowledge and inventive genius have been devoted to increasing the rate of production, and cheapening the article produced. I hope the time is now coming when our scientific knowledge and inventive power will be directed into a new channel, and will be devoted to rendering our manufacturing processes, of whatever kind, healthy for those employed.

As a step in that direction, I venture to suggest that the Society of Arts might well take up such questions, and by special inquiries promote the introduction of harmless substitutes and better processes. This question, for instance, of white-lead substitutes is ripe for a special inquiry by some body of recognised standing.

DISCUSSION.

The CHAIRMAN said this was a subject which the Society had always had at heart, for he found that, so early as 1778, a premium of £50 was offered for a preparation of white-lead which should not be injurious to health, but, apparently, it met with no response. In 1790 a gold medal was offered, and in 1820 £100 was offered for a substitute for ordinary white-lead. From time to time substitutes had been suggested, and experiments made; but one might go much further back, and show that this interest in carbonate of lead had existed from a very early period. It formed a cosmetic, which the early Greek ladies were very partial to; and it was asserted that an accidental fire in the Piræus, at which a pot of it was burned, gave the beautiful red oxide of lead, which was also used for similar purposes. Apart from this, the early history of the subject was extremely interesting. Otto Tachen, in 1630, was responsible for the first assertion as to the saponifying action of litharge and other lead compounds. One very important question in connection with these substitutes was their power of protection. When the old Hammersmith-bridge was removed, it was purchased by Sir William Arroll, who was then making experiments preparatory to the erection of the Forth-bridge, and it was found that those portions of Hammersmith-bridge which had been underground for about 85 years, were in perfect preservation, being coated with a paint, which on analysis proved to be nearly pure

white-lead. It remained to be seen whether any of these substitutes would be equally efficient. It was of course very important that they were not appreciably poisonous. He might mention that the committee appointed by the Home Secretary to examine this question was very much indebted to Mr. Laurie.

Mr. R. W. MACBETH, A.R.A., said he should have liked to hear more said as to the value of these pigments for artists' purposes. His own experience was that white-lead was exceedingly durable as regards consistency and tenacious qualities, but in colour it was liable to be affected by the atmosphere. Zinc was much less affected in that way, but it became more brittle, and liable to injury by handling or moving.

Mr. J. B. HANNAY said Mr. Laurie had treated the subject in a very impartial and open-minded manner, but there were two or three scientific points which he should like to refer to, having been working at the subject for some years. The durability of a paint must be treated of in two ways, first, as to colour, and, secondly, as forming a protective tissue. Thus, experiments on all sorts of pigments, including sulphate of barium, oxide of iron, fine clay, and white-lead showed that the protective power of paint was absolutely dependent on the tissue of the oxidised oil it formed on the substance coated. Even carbonate of lead when exposed to the pure wind from the Atlantic on the west coast of Scotland, 200 feet above the sea, he had found, in six months, quite honeycombed, and the surface quite porous, as it is soluble in rain water containing carbonic acid, so that a drop of oil put upon it would sink in as into a sheet of paper, whilst oxide of iron, sulphate of barium, or even sulphate of lead, when tried in the same manner, were not found to be affected—a drop of oil would not spread. White zinc also was very little affected; it all depended on whether the pigment used was soluble in rain water. He was sorry Mr. Laurie had not gone further into the question of sulphide of zinc; it ought to have done well, and did do well for a time, but it was ruined by a change in the mode of manufacture. If it were precipitated with sulphate of barium, and the double salt thus formed together retorted, it made a very good pigment, but, in order to produce it more cheaply, the sulphide of zinc was procured alone, and mixed mechanically with the barium; though it was chemically the same, the result was totally different. Sulphide of zinc was affected by light very easily, and became phosphorescent, and in doing so changed its colour, and by this change of method the manufacturers practically killed it. His experiments showed that the compression of the oxide of zinc, or of any other pigment, had really no effect, except that the increased density obtained by the compression merely enabled a greater weight to be applied in one application, so that with the uncompressed

oxide of zinc it would take six or eight coats to produce the same effect as three of the compressed, and, of course, that was prohibitory, because the cost of labour was greater than that of the material used; oxide of zinc, weight for weight, was as good as lead. Freeman's white was very good, because the oxide of zinc was capable of very fine division, and could thus be intimately mixed with a neutral sulphate, like sulphate of barium or sulphate of lead. Pigmentary power was a function of the density of any colour. If there were an excess of oil in the Glasgow white, it was the fault of the grinding. Sulphate of lead could be brought up to 6 or 7 per cent. of oil, if properly ground and fed—*i.e.*, dry powder added to it, and further ground, as was the usual practice now. Covering power depended on two things—the whiteness of the colour, and its opacity. The mixture of only a few grains of lampblack with white-lead would take off the fine edge of its colour, and it would require four coats to cover, as well as three of pure colour. Opacity also was very important. When the fumes of sublimed sulphate of lead were passed along a flue in such a way that the particles were very fine and spherical, their covering power was exceedingly small; but if they were collected in flakes, like snow, their covering power was very high. To make accurate tests in the way described in the paper, dry colour must be taken in the first instance, and the oil and turps used with it also measured with the utmost nicety; the addition of only a few drops would make the brush slip along and leave less on the surface, and thus affect the result. He was at first puzzled to understand why white-lead paint in a pure air turned grey, but he ultimately satisfied himself that it was owing to the honeycombing effect which he had previously described, owing to the solubility of white-lead in rain water, and to meteoric or other dust particles becoming embedded in the surface. For the same reason, iron rusted under white-lead when exposed to the air. The preparation of paint for artists' use was a pure question of grinding. Mr. Holman Hunt had had some white from him which resisted the action of smoke and bad air, but he complained of the consistence of it. On making further inquiries he found that pigments for artists' use were ground in a special way, sometimes passing as many as thirty times through the rollers; it was a question of manufacture, not of material. Oleates were all solid bodies, and though they stiffened the substance, they ruined the paint, which always took a yellow tone after a few months. If white lead, in grinding, were allowed to get too hot, it formed an oleate, but the workmen knew that the batch was spoiled. He had written to Professor Church on this subject, stating his conviction that not one-millionth part of oleate of lead was formed in any white-lead properly made. All oleates of lead were soluble in ether, whether basic or not. With regard to the effect on health, all lead compounds were

poisonous, and many persons were poisoned even by handling lead pipes; some men got ill by merely shovelling the galena at the mine, whilst others were unaffected. Taking it roughly, however, carbonate of lead was a fatal poison, and sulphate or sulphide was not. On one occasion he went through some flues and breathed and swallowed a certain quantity of the dust, of which he was not conscious at the time, but a few days afterwards on taking a little acetate of ammonium, which acted as a solvent of the sulphide in his stomach, he was seized with symptoms of metallic poisoning. Practically, however, it might be said to be non-poisonous.

Mr. WHITELEY remarked, that although much stress was laid on the discolouration of white-lead, not 3 per cent. of that used was, in fact, used as white, but as a body.

Sir HENRY TYLER said that, though it was very desirable to prevent poisoning in the manufacture, it was equally necessary to prevent poisoning in the use of white lead. For that reason, feeling the importance of obtaining an innocuous white pigment, he had for some years devoted a good deal of time and money to the development of Mr. Hannay's patent, and, ultimately, had been very successful. Improvements had been made until now a very high degree of perfection had been obtained. After having a great deal of trouble with many drying processes, they had come to the conclusion that they could do without drying altogether, and were now taking the wet pulp from the presses and putting it direct into pug mills above the rollers. Oil was introduced on the top, which drove out the water, and it was then pressed through the rollers with the proper amount of oil; and in that way the very best product was obtained, far better than that which had been dried. They now obtained in this way a white lead better in colour than the best carbonate, and of at least equal covering power. The yield also had been very much improved, and they were now able to turn galena, containing 80 to 81 per cent. of lead, into a sulphide of lead, with 109 or 110 per cent. The manufacture, especially in fuel, had also been so economical, that they were approaching the point when the extra weight of white-lead, compared to the lead in the galena, would be sufficient to pay for the whole manufacture. They could sell the product £3 a ton cheaper than the ordinary white-lead, and yet make a good profit, so that he hoped, before long, they would be able to oust entirely the old method of manufacture, whereby so much evil was caused.

Mr. R. H. HARLAND said he should like further particulars as to the way in which Mr. Laurie's experiments had been carried out. He had made many experiments himself, especially by mixing a certain weight of colour with a known weight of pigment, and though he at times thought he had obtained definite

results, he eventually came to the conclusion that they were absolutely worthless, and might even be misleading. He had found that the cheapest continental stuff sent to this country—far inferior in specific gravity and body—would give better results by this method than a good sample of stack white-lead. The difficulty in determining relative covering power was in making allowance for the quantity of paint which adhered to the brush; and the total amount employed for the test being so small—only a little over an ounce—he thought it was impossible to obtain reliable results as to the quality of the pigment. If a row of houses or a railway station were experimented upon, the result would be of some practical value. As regards Mr. Hannay's remarks, if it be correct, that the protective power is due simply to the film of linseed oil oxidised on the surface, it would follow that all paints—red-lead, oxide of iron, or hæmatite ore—ground fine and mixed with linseed oil, should be equally good as regarded covering power and durability.

Mr. HANNAY said this was quite true, and the best protection for iron work was an extremely fine oxide of iron, which was found naturally in certain parts of the world—so fine, that no amount of grinding could compete with it—mixed with oil.

Mr. LAURIE, in reply, said Mr. Hannay's own remarks had explained why he had not experimented with the zinc sulphide; he could not meet with any satisfactory specimen, or even ascertain whether it was still being sold. Mr. Hannay's explanation of why it failed was very interesting, and was just what one would expect. He had, of course, been dealing with the subject more from the house painter's than the artist's point of view, but sulphate of lead was much less likely to affect other pigments than carbonate, because it was a more stable compound. Oxide of zinc was much safer to use than carbonate of lead for the same reason. As at present prepared, he knew it was regarded by artists as being more apt to crack, and no doubt that opinion was based on experience, but he had not tested it long enough to be able to give a personal opinion. He had some very elaborate experiments going on at present—the paint being alid on canvas much in the same way as was done by artists—with sulphate of lead, oxide of zinc, and carbonate of lead, mixed with oil, varnish, petroleum, and different mediums, so that he hoped to be able to deal with the artists' side of the question more fully hereafter. In the meantime, where an artist was engaged in decorative work, such as that around the room they were in, which was not exposed to the sun or rain, but to impurities in the air, it was far safer to use oxide of zinc, Freeman's white, or, possibly, the Glasgow sulphate, than white-lead, which would certainly suffer, not only in the whites, but in all the delicate shades into which white entered.

That was why he must differ from Mr. Whiteley. No doubt the greater part of the white-lead employed was used for mixing with other colours, but the change in the lead affected those colours if they were at all delicate. He should like to have Mr. Whiteley's opinion on the question of grinding wet, because if this could be done successfully, two-thirds of the danger to the workpeople would disappear. He agreed with Mr. Harland that it was useless to attempt to test covering power, by mixing white-lead with another pigment, and trying to get two shades the same. The quantities he had used were, no doubt, small, but the results were, at any rate, a first approximation. The real test, of course, would be the painting of a railway station, but that was beyond his reach. There was no difficulty with regard to the paint adhering to the brush; if you first weighed the pot of paint and brush together, and then did the same thing again, after putting on the coat, the difference was the weight of paint used.

Mr. WHITELEY said he tried wet grinding 20 or 30 years ago, and had tried it several times since, but had given it up as a bad job. To his own mind the result was perfect, but to the mind of the painter, or to the one who used it for corticine, it was not so. They always found, here and there, a globule of water left in the lead, which formed a minute bladder or skin, and spoiled delicate work.

Mr. HARLAND also said the process of wet grinding was adopted in a works some 20 years ago, at his suggestion; but though hundreds of tons were sent out, they had so many complaints from all parts of the country, that it had to be abandoned.

Sir HENRY TYLER said he did not claim this process as a discovery, and he was quite aware that it had been used long ago both in France and in America. They had simply applied it to their sulphate of lead manufacture, and their customers liked the product better than when it was ground dry.

The CHAIRMAN then proposed a vote of thanks to Mr. Laurie, which was carried unanimously.

Miscellaneous.

CHICAGO EXHIBITION.

The following exhibitors in the British Section of the World's Columbian Exhibition have presented certain of their exhibits to the newly-formed Columbian Museum at Chicago:—

Albion Clay Co., Limited, Albion Works, Woodville, Burton-on-Trent.

Ardeshir and Byramji, 22, Oxford-street, London, W. Arnold, P. and J., 155, Aldersgate-street, London, E.C.

Art Union of London, 112, Strand, London, W.C. Ault, Wm., Swadlincote, near Burton-on-Trent, Staffordshire.

Baker, A. P., 57, Deansgate, Manchester.

Barr, Andrew, Copthall-avenue, London.

Bartleet and Sons, William, Abbey Mills, Redditch, Worcestershire.

Bhumgara and Co., F. P., 135, London-wall, London, E.C.

Ordnance Survey of Great Britain and Ireland, Southampton.

Brown and Co., Limited, John, Atlas Works, Sheffield.

Buchanan, James, 62, Dale-street, Tradeston, Glasgow.

Bull, Wm., 536, King's-road, Chelsea, London.

Bushill, T. W., Brantwood, Coventry, Warwickshire.

Calvert and Co., F. C., Gibbon-street, Bradford, Manchester.

Cheesewright, Fredk. Henry, 60, Haymarket, London, S.W.

Combe, Barbour, and Combe, Limited, Belfast.

Cook and Son, Thomas, Ludgate-circus, London, E.C.

Cooksey and Co., 15, Bennett-street, Stamford-street, London, S.E.

Cory Brothers and Co., Limited, Cardiff, South Wales.

Cowham, Joseph H., Westminster Training College, Horseferry-road, London, W.

Crown Preserved Coal Co., The, Limited, Cardiff.

Curtis's and Harvey, 74, Lombard-street, London, E.C.

Decorative Art Journals Co., Limited, 76z, Mosley-street, Manchester.

East Anglian Cement Company, Shepreth, Cambridgeshire.

Francis and Co., Limited, Bridge Foot, Vauxhall, London, S.E.

Fuller's Earth Mining Company, Limited, Woburn Sands, Buckinghamshire.

Fuller's Earth Union, Limited, 24, Budge-row, London, E.C.

Gibbs and Co., Limited, 79, Mark-lane, London, E.C.

Great Northern (Ireland) Railway Company, Dublin.

Indian Government, Revenue and Agricultural Department, Simla.

Indian Tea Association, Calcutta.

International Water and Sewage Purification Co., Limited, 7, Victoria-street, London, S.W.

Irish Railway Companies, Dublin.

Johnson, Edmond, 94, Grafton-street, Dublin.

Johnston, W. and A. K., Edina Works, Easter-road, Edinburgh.

Knowles, Henry, 18, New Bridge-street, Blackfriars, London, E.C.

Lawrence, William, 5 to 7, Upper Sackville-street, Dublin.

London and North Western Railway Co., Euston Station, London, N.W.

Low Moor Co., Limited, Low Moor Iron Works, near Bradford, Yorkshire.

Lower Lansalson China Clay (Kaolin) Co., St. Austell, Cornwall.

Maw and Co., Limited, Benthall Works, Jackfield, R.S.O., Shropshire.

Messer and Thorpe, 8, Quality-court, Chancery-lane, London, W.C.

Midland Railway Co., Derby.

Musselburgh Wire and Steel Works (W. N. Brunton), Musselburgh, Scotland.

Mysore State of India.

Oeffelein and Co., 54, Berners-street, Oxford-street, London, W.

Ormes, Upsdale, and Co., 4, Falcon-avenue, London, E.C.

Peake, Thomas, The Tileries, Tunstall, Staffordshire.

Robertson, Ledlie, Ferguson, and Co., Limited, The Bank Buildings, Belfast.

Schloss, David F., 1, Knaresborough-place, Cromwell-road, London, S.W.

Smith and Son, C., 63, Charing-cross, London, S.W.

Sprules, Sarah, The Distillery, Wallington, Surrey.

Tuck and Sons, Raphael, 72 and 73, Coleman-street, London, E.C.

Turner, Wm., and John, Wigan Junction Colliery, Wigan, Lancashire.

Usher, Richard, Bodicote, Banbury, Oxon.

Wells, John, 508, Oxford-street, London, W.

York and Son, 67, Lancaster-road, Notting-hill, London, W.

The Mineralogical and Metallurgical Collections formed for the Royal Commission were also presented to the Columbian Museum.

Other important presentations of exhibits were as follows :—

Doulton and Co., "Statue of America," to the City of Chicago.

Government of India Forestry exhibit, to the United States Department of Agriculture.

Royal Geographical Society's exhibit, to the University of Chicago.

Science and Art Department (one plaster cast and pedestal), to the Detroit Museum of Art School.

Bureau of Charities, Correction, and Philanthropy, portion of the exhibit presented to the Johns Hopkins University of Baltimore.

BOOK AND PAPER EXHIBITION, PARIS.

An International Exhibition, in connection with the book, paper, and printing industries, is announced to open in July next at the Palais de l'Industrie,

Paris, under the patronage of the Ministers of Commerce, Instruction, and Public Works. The committee includes several well-known authors, editors, publishers, printers, and paper makers, the General Commissioner is M. Lucien Layus, and the Director M. G. Sénéchal, 28 rue Laumartin, Paris.

The objects admissible are divided into fourteen groups, sub-divided into thirty-seven classes. The first group, Paper, includes Class 1, raw materials for making paper, its manufacture, bleaching, dyeing, and disinfection; Class 2, specimens of paper for printing by various processes, for writing and for packing; Class 3, wall and ornamental papers; and Class 4, cardboard with articles made for it. Group II. is sub-divided into Class 5, raw materials for printing; and Class 6, inks and colours. Group III. embraces paper-making machines, printing presses, prime movers, and printing plant. Group IV. specimens of all kinds of printing. Group V., Photography, and the graphical arts dependent upon it, is sub-divided into three classes, viz., Class 14, photographic apparatus; Class 15, chemicals; and Class 16, specimens of photographs by all processes. Group VI., Books, is also sub-divided into three classes, viz., Class 17, *éditions de luxe* and cheap editions, with works for the blind; Class 18, maps and plans; and Class 19, musical works, including those for the blind. Group VII., stitching and binding, is sub-divided into Class 20, specimens of *reliures de luxe* and cheap binding; and Class 21, materials for binding. Group VIII. is devoted to the fine arts; Group IX., to the Press; Group X., to a retrospective exhibition; and Group XI. to the collective exhibition of societies. Group XII., furniture for and housing of the book, is divided into Class 30, libraries, bookcases, steps, &c.; Class 31, the warming of libraries, the lighting of ditto, and composing rooms; Class 33, plant for the transport of books and journals. Group XIII. is divided into three classes: Class 34, writing machines, with a competition of typewriters; Class 35, office requisites, such as files, copying presses, and writing materials; and Class 36, articles made of paper, not included in the other classes. Group XIV. has only one class, embracing new inventions connected with all the classes.

Applications for space must be made at the above address before the 30th April, and the Exhibition is to be kept open at least until the 23rd November, 1894.

MARRAM GRASS.

The following account of the successful planting of Marram grass on a large extent of sandhills is taken from the Melbourne newspaper, the *Leader* :—

"The Marram grass (*Psamma arenaria*), the seed of which was first introduced into the colony of Victoria by the Government botanist, Baron von Mueller, in 1883 (and by him entrusted to the

Borough Council of Port Fairy for experiment on the barren shifting sand hummocks fronting the coast line of Port Fairy), has been proved to be the most effective sand stay ever planted. Practical evidence of its value can be seen in the 50 miles of sandhills extending between Warrnambool and Port Fairy, now reclaimed by the Marram plantations, sown under the direction of Mr. S. Avery, the park ranger. So complete has been the reclamation of the lands that, where a few years ago not a sign of vegetation was to be seen, there now exists a succulent grass, eagerly devoured by cattle, and growing to the height of 4 feet. Marram grass is practically indestructible—burning, cutting, or eating off only makes it thrive—whilst, in exposed, shifting sand, it propagates as surely as in the most sheltered position. The grass for transplanting has been supplied by the Port Fairy Borough Council, not only to the Governments of Victoria and New South Wales, but to numerous municipal bodies and private individuals in all the Australian colonies, New Zealand, and Tasmania, and in no single instance has it failed to thrive. The grass is supplied at the actual cost of digging, packing, and carting to the wharf or railway station, Port Fairy, which does not exceed 25s. per ton. The grass is planted in rows, at a distance of 6 feet apart, the space between the plants at least 2 feet. The depth to which each plant is put into the sand depends upon the nature of the sand. If in sand not likely to drift for two or three months, 9 inches is deep enough; but, if very loose and shifting, the grass should be placed from 12 to 15 inches deep. A “plant” consists of as much grass as a man can conveniently hold in his hand, and care is taken to have the roots regular. The system adopted in planting is for one man to dig the hole, and another puts in the “plant,” and well treads round the same. After 12 months’ growth, the plants are fit for thinning out and transplanting. Cattle are not allowed to graze on the grass until the roots become thoroughly established. It takes 3,630 “plants” to the acre, and there are about 2,800 “plants” to the ton; thus, 1 ton 6 cwt. covers one acre. The most favourable time for planting is from the 1st May to the end of July. The grass retains its vitality, and strikes root after being out of its sand bed for three months or more. In a report upon the grazing capabilities of the grass, furnished to Baron von Mueller by Mr. Avery, from Port Fairy, under date the 18th inst., he says:—“I generally put the cattle into the Marram grass enclosure after the first rains we get in April, and then allow them to graze there until the season begins to get too dry, when they are taken out and kept off till next season. I have been able to keep them in longer this season on account of the late rains we have had. During the last season, I have had about 100 head of cattle grazing on about 100 acres of Marram grass for six months, and the cattle kept in fair condition during that time. There seems to be some doubt in the minds of a great many persons, who have heard about the

Marram grass, that it is of no use as fodder; but I can assure you that the cattle at Port Fairy thrive well on it, and, if it was not for the grass during the winter months, the residents’ cattle would fare badly. I am of opinion that it would make a splendid ensilage.” Many hundreds of acres of the valuable potato lands bordering the western coast of Victoria have already been saved from destruction by this valuable grass; and the grateful testimony of the farmer is, that “if Baron von Mueller had conferred no other benefit on the colony than this alone, out of all his other good works, he would deserve to live in grateful remembrance as a great public benefactor.” Amongst the latest applications for plants of this grass are several from India and Africa.”

FRENCH WINE PRODUCTION IN 1893.

It appears, from a report just issued by the French Minister of Finance, that the wine crop of that country during the past year is estimated at 1,095,600,000 gallons, that is, an increase of 455,400,000 gallons, as compared with the previous year, and of 459,800,000 gallons, if the average of the last ten years be taken. If Corsica and Algeria are added, the total wine production exceeds 1,188,000,000 gallons. The great increase in production is due, partly to the reconstruction of a great number of the vineyards, which are now in excellent condition; but, what it is chiefly owing to is, that throughout the whole of the country, viticulture greatly benefited last year by climatic conditions, which were exceedingly favourable. If the centres of the production of the Mediterranean littoral (Pyénées Orientales, Aude, Hérault, Gard, Bouches-du-Rhône, and Var) had been as favoured in the same way as the other departments, the harvest would have been a still more exceptional one. These six departments together yielded 381,084,000 gallons (Pyénées Orientales, 40,524,000 gallons; Aude, 97,130,000; Hérault, 158,136,000; Gard, 45,012,000; Bouches-du-Rhône, 26,620,000; and Var, 13,662,000 gallons), as compared with 346,324,000 gallons, in 1892, an increase of 10 per cent. As regards the other departments, their yields during the past year, as compared with those of 1892, were as follows, the figures for 1892, being, in each case, stated in brackets:—Gironde, 108,416,000 gallons (40,568,000); Gers, 44,066,000 (14,300,000); Landes, 17,446,000 (5,412,000); Lot-et-Garonne, 13,376,000 (5,984,000); Haute Garonne, 13,090,000 (6,710,000); Basses Pyénées, 12,386,000 (3,366,000); Tarn-et-Garonne, 12,452,000 (5,060,000); Côte d’Or, 13,706,000 (6,666,000); Yonne, 28,908,000 (6,116,000); Saône-et-Loire, 17,182,000 (9,020,000); Loire Inférieure, 56,760,000 (7,348,000). The 1893 wine harvest was not only remarkable for its abundance, but it was also an excellent one as regards the quality of the production.

THE BENGAL LAC INDUSTRY.

Lac or gum lac is a substance produced in Bengal on the leaves and branches of certain trees by a small insect, the *coccus ficus*. The trees selected are principally the *Ficus indica*, *Ficus religiosa*, and *Rhamnus Fufuba*. There are three kinds of lac known in commerce, distinguished by the names of stick lac, seed lac, and shellac. Stick lac is the substance in its natural state; it is of a reddish colour and incrusts small twigs. When broken off and boiled in water it loses its red colour, and is then termed seed lac, and when melted and reduced to the state of thin sheets it is called shellac, which has a yellowish-brown colour. The French representative at Calcutta has recently reported upon the present condition of the lac industry. He states that the finest descriptions are found in Assam and Bengal, and that coming from the former is a very important article of trade. Lac from Burmah, which is chiefly produced in the upper districts and the Shan States, is sent to Calcutta to be worked up. Burmah, it is stated, is in a position to supply endless quantities of lac, as the vast forests there contain so many descriptions of trees well adapted to its development. The districts of the Punjab and Mysore are large producers of lac, which is chiefly used at the place of production, its inferior quality rendering it unfit for exportation. Then come Bengal, Oudh, Scinde, and the Central Provinces, which yield lac. According to quality, it is sent to Calcutta to be melted, or to certain towns of the interior, such as Hyderabad and Mirzapore, for working up into bangles and other articles. There are large numbers of factories in India, but the greater part are of little importance, and only turn out products of very second-rate quality. The methods of manufacture vary according to district. Lac dye is used to a very considerable extent in dyeing. It is, however, in connection with furniture making that the largest quantity of lac is used, and this industry has of recent years made considerable progress in the provinces of Scinde and the Punjab. In making the furniture, a very light wood is used, which contains no resin and which can be easily worked. This wood is obtained from a species of poplar tree, and takes the lacquer easily. Lac is also used in making trinkets, such as bangles, rings, and other ornaments, which are worn by the women of the poorer classes. In Burmah, it is used in fastening sword blades in their handles, and in certain districts it is used in making whetstones by mixing a portion of powdered lac with three parts of river sand. In hat making, a mixture of lac, mastic pounce, and other resins, dissolved in alcohol, is used to stiffen silk hats, and in lithography lac is used in connection with the preparation of the ink. Mixed with resin and certain colouring material it makes sealing-wax. Lac also enters into the composition of numerous varnishes. In adding to a solution of lac in alcohol, a yellow clear substance such as gum gutta, saffron, &c., a liquid is obtained which gives

to copper and other metals the appearance of gold, while still preserving their brightness. Lac may be adulterated by the addition of resin, and this frequently happens in the case of lac of native preparation, and the proportion of resin sometimes amounts to as much as 25 per cent. Its presence is easily recognised by the smell when a piece of lac is broken between the fingers. The quantity of lac exported in 1892-93 amounted to 125,246 cuts, valued at 7,787,583 rupees. In the preceding year the value amounted to 7,444,460 rupees. The principal customers for lac are first England, and then the United States, Germany, France, Austria, Australia, &c. The exports of lac dye appear to have entirely ceased during the last four years.

Correspondence.

CARRIAGEWAY PAVEMENTS.

Mr. ARTHUR VENTRIS writes respecting the print of his former letter (see *ante*, p. 89, col. 2):—My attention has been called to an error in the print of the proceedings in some observations I made on the above subject, with regard to the price charged by the New River Company for water for street flushing purposes, *six shillings* being given as the price per 1,000 gallons; whereas the price is *sixpence*, found to be equivalent to a rate of 3s. per hour through an open hose, and 1s. 9d. per hour through a $\frac{3}{4}$ flushing nozzle. On this subject of "street cleansing," I may mention that in the area referred to (10 $\frac{1}{2}$ miles of streets, and adjacent courts) the New River Company have supplied during the recent snowstorm an amount of water returned at upwards of one and a quarter million gallons for street washing.

General Notes.

SANTIAGO (CHILE) MINING AND METALLURGICAL EXHIBITION.—The Department of Science and Art has received through the Foreign-office a despatch from her Majesty's Minister in Chile, in which it is announced that the opening of this Exhibition, which was fixed for April next (see *ante* p. 44), has been postponed until the following September; but that, notwithstanding this deferred date of opening, all proposed exhibits can at once be forwarded to Santiago.

CONGRESS OF HYGIENE.—The eighth International Congress of Hygiene and of Demography will be held at Budapesth, in September, 1894. The programme of subjects is as follows:—Division I. Hygiene.—Section 1, Etiology of infectious diseases—bacteriology; (2) prevention of epidemics; (3)

hygiene of hot climates; (4) professional hygiene; (5) hygiene of infancy; (6) of school life; (7) of diet; (8) of towns; (9) of public buildings; (10) of lodgings; (11) of railways and ships; (12) military hygiene; (13) red cross societies; (14) life saving (15) sanitary police; (16) hygiene of sport; (17) of watering places; (18) veterinary medicine; (19) pharmacy. Division II. Demography.—Section I. History; (2) anthropometry; (3) technical demography; (4) demography of the agricultural classes; (5) of the industrial classes; (6) of large towns; (7) statistics of corporal and intellectual defects.

ACOUSTIC FIREDAMP INDICATOR.—A new fire-damp indicator was lately brought before the French Société d'Encouragement pour l'Industrie Nationale by Colonel Laussedat, Director of the Paris Conservatoire des Arts et Métiers. The apparatus, called "Formèneophone," by its inventor, M. E. Hardy, depends upon the fact that an organ pipe gives a different number of vibrations, and therefore a sharper or flatter sound, according to the density of the gas or air by which it is blown. On placing a sonorous tube in the workings of a mine, M. Hardy has been able to determine, by its sound, the per-centage of firedamp, or carbonic acid gas, contained in the atmosphere; and so sensitive is the apparatus, that the tube is stated to give out a different sound in a closed room, after a single person has remained therein for several hours, from that at the commencement.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

JANUARY 24.—"American Carriages." By G. HERBERT THRUPP. SIR JOHN B. MONCKTON, F.S.A., Master of the Coach Makers' and Coach Harness Makers' Company, will preside.

JANUARY 31.—"Californian Wines." By CHARLES F. OLDHAM.

FEBRUARY 7.—"Reproduction of Colour by Photography." By CAPTAIN W. DE W. ABNEY, C.B., F.R.S.

FEBRUARY 14.—"The St. Pancras Electric Light Installation." By HENRY ROBINSON, M.Inst.C.E.

FEBRUARY 21.—"Electric Signalling without Wires." By WM. HENRY PREECE, C.B., F.R.S. SIR RICHARD WEBSTER, G.C.M.G., Q.C., M.P., Chairman of the Council, will preside.

Papers for which dates have not yet been fixed:—

"London Coal Gas and its Enrichment." By PROF. VIVIAN LEWES.

"Automatic Balance of Reciprocating Machinery, and the Prevention of Vibration." By W. WORBY BEAUMONT.

"Experiments in Aeronautics." By HIRAM S. MAXIM.

"Automatic Gem and Gold Separator." By WILLIAM S. LOCKHART.

"Application of Electricity to the Disinfection of Sewage." By MONS. HERMITE.

"Rainfall Records in the British Isles." By G. J. SYMONS, F.R.S.

"Refrigerating Apparatus." By PROF. LINDE.

"Design Applied to Carpets." By ALEXANDER MILLAR."

INDIAN SECTION.

The meetings of February 15, March 8, April 26, and May 24, will be held at the Society of Arts; those of February 8, and March 19, at the Imperial Institute.

THURSDAY, FEBRUARY 8, at 4.30 p.m.—"Telegraphic Communication between England and India: its Present Condition and Future Development." By E. O. WALKER, C.I.E., M.I.E.E., formerly of the Government of India Telegraph Department. SIR THOMAS SUTHERLAND, K.C.M.G., M.P., will preside.

THURSDAY, FEBRUARY 15, at 4.30 p.m.—"Experiences at the Court of Afghanistan." By JOHN A. GRAY, late Surgeon to His Highness Abdul Rahman Khan, Ameer of Afghanistan. The HON. GEORGE N. CURZON, M.P., will preside.

THURSDAY, MARCH 8, at 4.30 p.m.—"The Indian Currency." By J. BARR ROBERTSON.

MONDAY, MARCH 19, at 8.30 p.m.—"Indian Railway Extension: its Relation to the Trade of India and of the United Kingdom." By JOSEPH WALTON. SIR JAMES KITSON, Bart., M.P., will preside.

THURSDAY, APRIL 26, at 4.30 p.m.—"Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh." By SIR AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieutenant-Governor of the North-West Provinces and Oudh.

THURSDAY, MAY 24, at 4.30.—"Chota Nagpore: its Mineral Wealth and its value to India." By J. F. HEWITT, late Bengal Civil Service. SIR ALEXANDER WILSON, formerly President of the Bengal Chamber of Commerce, will preside.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on Tuesdays, at Eight o'clock:—

JANUARY 23.—"Morocco and its Races." By Captain CHARLES ROLLESTON. LORD COLCHESTER will preside.

FEBRUARY 20.—"The Antwerp Exhibition, 1894." By EDOUARD SÈVE.

MARCH 6.—"Travels on the Zambesi." By MONS. FOA.

APRIL 17.—"Tasmania and the forthcoming Hobart International Exhibition, 1894-95." By J. F. ECHLIN.

MAY 1.—"Paraguay." By A. F. BAILLIE.

MAY 29.—"Education in Victoria." By Prof. C. H. PEARSON, M.A., LL.D.

APPLIED ART SECTION.

Tuesday Evenings, at Eight o'clock :—

JANUARY 30. — "The Adam Architecture in London." By PERCY FITZGERALD, M.A. Colonel ROBERT W. EDIS, F.S.A., will preside.

FEBRUARY 13. — "Modern Development of Illustrated Journalism." By HORACE TOWNSEND.

FEBRUARY 27. — "Goldsmiths' Work: Past and Present." By Mrs. PHILIP NEWMAN.

MARCH 13. —

APRIL 10. — "The Evolution of Decorative Art." By HENRY BALFOUR, M.A.

MAY 8. — "Pewter." By J. STARKIE GARDNER.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock :—

PROFESSOR FRANK CLOWES, D.Sc., "The Detection and Measurement of Inflammable Gas and Vapour in the Air." Four Lectures.

LECTURE I. — JAN. 22. — The necessity of detecting minute proportions of fire-damp, coal-gas, and petroleum vapour in air—Early tests for fire-damp with the naked candle flame—Later tests with the Davy lamp—Improvements in tests with oil flame of safety-lamp—Use of benzoline flame in safety-lamp.

LECTURE II. — JAN. 29. — Attempts to utilise diffusion and other physical processes—Liveing's electrical indicator—Apparatus depending upon the alteration of volume caused by burning the gas—Apparatus depending on the measurement of volume of gas required to bring the mixture to the ignition point.

LECTURE III. — FEB. 5. — Employment of a large alcohol flame in a special lamp—Recent modifications—Application of a standard hydrogen flame in an ordinary illuminating safety-lamp—Attempts to use a small alcohol flame in an ordinary safety-lamp.

LECTURE IV. — FEB. 12. — Application of the standard hydrogen flame to the detection and measurement of petroleum vapour in tanks and other spaces—The test-chamber apparatus for observing and measuring the indications of the above testing apparatus.

HUGH STANNUS, F.R.I.B.A., "The Decorative Treatment of Traditional Foliage." Four Lectures.

February 19, 26; March 5, 12.

CAPTAIN W. DE W. ABNEY, C.B., F.R.S., "Photometry." Three Lectures.

April 2, 9, 16.

HENRY CHARLES JENKINS, A.M.Inst.C.E. "Typewriting Machines." Two Lectures.

April 30; May 7.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 22 ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. Frank Clowes, "The Detection and Measurement of Inflammable Gas and Vapour in the Air." (Lecture I.)

Scottish Society of Arts, 117, George-street, Edinburgh, 8 p.m. 1. Mr. H. Ramsay Taylor, "Electric Railway Signalling." 2. Mr. H. Ramsay Taylor, "An Improved Form of T-Square, with Transparent Edge." 3. Mr. H. W. Pearson, "Pearson's Patent Drilling Apparatus for Effecting Junctions with Gas and Water Mains."

Imperial Institute, South Kensington, 8½ p.m. Mr. E. G. Ravenstein, "The British Empire as a Geographical and Commercial Unit."

Surveyors, 12, Great George-street, S.W., 8 p.m. Discussion on the Paper by Mr. E. J. Harper, "Trade Claims."

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. T. Hodgkin, "The Roman Wall in Northumberland."

TUESDAY, JAN. 23 ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Foreign and Colonial Section.) Captain Rolleston, "Morocco and its Races."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Charles Stewart, "Locomotion and Fixation in Plants and Animals." (Lecture II.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. "The Tunnels of the Dore and Chinley Railway," by the late Mr. Percy Rickard.

Photographic, 50, Great Russell-street, W.C., 8 p.m. Technical Meeting.—Paper on "Lantern Slide Processes."

Anthropological, 3, Hanover-square, W., 8½ p.m. Annual Meeting.

WEDNESDAY, JAN. 24 ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. G. Herbert Thrupp, "American Carriages."

Geological, Burlington-house, W., 8 p.m.

Royal Society of Literature, 20, Hanover-square, W., 8 p.m.

East India Association, 3, Victoria-street, S.W., Mr. Lesley Charles Probyn, "The New Rupee."

THURSDAY, JAN. 25 ... Royal, Burlington-house, W., 4½ p.m. Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 9 p.m. Prof. Bridge, "A Talk about the Orchestra."

Royal Institution, Albemarle-street, W., 8½ p.m. Rev. Canon Ainger, "The Life and Genius of Swift." (Lecture II.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Mr. W. H. Preece, "Notes of a Trip to the United States and to Chicago, 1893."

FRIDAY, JAN. 26 ... Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Mr. A. P. Graves, "Old Irish Song" (with vocal illustrations by Mrs. Hutchinson and Madame Marie Bréma).

Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Dr. J. F. J. Sykes, "Elementary Physics." (Lecture I.)

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Science Schools, South Kensington, S.W., 5 p.m. 1. Mr. J. W. Kearten, "A New Mode of Making Magic Mirrors." 2. Mr. W. B. Croft, "Some Observations in Diffraction." 3. Mr. J. W. Spurge, "A New Photometric Method and Photometer."

SATURDAY, JAN. 27 ... Botanic, Inner-circle, Regent's-park, N.W., 3½ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. W. H. Cummings, "English School of Musical Composition." (Lecture II.)

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No. 2,149. VOL. XLII.

FRIDAY, JANUARY 26, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

SWINEY PRIZE.

A meeting of the adjudicators of this prize, appointed by the will of the late Dr. Swiney, was held on Monday, January 22, 1894, at the Society of Arts, at 4.15 p.m. Sir RICHARD WEBSTER, G.C.M.G., Q.C., M.P., Chairman of the Council, in the chair.

The Secretary read the advertisement convening the meeting.

The Secretary read a report from the joint Committee of the Society of Arts and the College of Physicians, recommending that the prize should be awarded to Thomas Erskine Holland, D.C.L., of Lincoln's-inn, Barrister-at-Law, Chichele Professor of International Law in the University of Oxford, for his work entitled "Elements of Jurisprudence."

It was thereupon moved by Sir Richard Webster, and seconded by Dr. Munk, Librarian to the College of Physicians, and carried, "That the prize, a silver goblet value £100, containing gold coin to the same amount, be adjudged to Professor Thomas Erskine Holland, D.C.L., the author of a published work on 'The Elements of Jurisprudence.'"

The cup has been executed by Messrs. Garrard, from a design made expressly for the Society by the late Daniel Maclise, R.A.

CANTOR LECTURES.

On Monday evening, 22nd inst., Professor FRANK CLOWES delivered the first lecture of his course of Cantor lectures on the "Detection and Measurement of Inflammable Gas and Vapour in the Air."

The lectures will be printed in the *Journal* during the summer recess.

Proceedings of the Society.

INDIAN SECTION.

Thursday, January 18, 1894 (at the Imperial Institute); Sir JAMES LYLE MACKAY, K.C.I.E., in the chair.

The paper read was—

THE PETROLEUM FIELDS OF INDIA: THEIR PRESENT CONDITION AND THEIR PROBABLE FUTURE.

By R. D. OLDHAM, A.R.S.M.
Superintendent Geological Survey of India.

The words "golden age" are familiar as representing a mythical period when evil was unknown, and the terms ages of stone, bronze, and iron are used by archæologists to denote successive stages in the development of the knowledge of the arts by man. In fanciful analogy to these terms the present has been called an age of petroleum. In view of the manifold and wide-spread applications of petroleum, and that it is rapidly rivalling the thousand and one purposes for which the ingenious Celestial is said to use the bamboo, the phrase is not so much inappropriate as fantastic. In no country perhaps, and certainly in few, has the growth of the use of the manufactured products of petroleum been so rapid as in India, where one of the most striking features of the trade returns of recent years has been the great increase in the imports of petroleum. Besides this the last few years have seen several attempts to develop old, and discover new, oil-fields in India itself, and have witnessed an increase in the industries of producing the crude oil, and of its subsequent manufacture. The interest felt in the subject has caused so many exaggerated opinions, both optimistic and pessimistic, to be expressed, that it may not be amiss to give an unprejudiced account of the known oil-fields, of the present condition of the industry, and of its probable future.

Before taking up the description of the Indian oil-fields, it will be well to discuss the manner in which petroleum is distributed underground; this is necessary, as without some such introductory remarks, part of what follows could not be made intelligible, except by introduction of longer or shorter digressions. The subject, moreover, is one that is unsatisfactorily, where not inaccurately, dealt with in most of the text-books that have as yet been published. One of the best of these, by Professor Höfer, of Leoben, devotes some

space to a distinction between those fields in which the distribution of the oil is primary, and those in which it is secondary, primary distribution being defined as the original disposition of the oil in distinct beds, in which it may either have been deposited at the time of their formation, or may have been subsequently developed by chemical changes in the materials included in the sediments of which they are composed. From these beds the oil escapes through fissures penetrating the earth's crust, and is found in secondary distribution in these fissures, or in other strata, into which it has found a way through them. Theoretically the distinction is a real and important one, but from the purely commercial point of view, that is to say, as far as productive and workable fields are concerned, the distinction is not merely unimportant, but unreal. There are no fields of any importance in which the oil occurs in fissures of the nature described by Professor Höfer, and, seeing that petroleum is a fluid of an exceptionally mobile and penetrating nature, we may well believe that, even where it is now found in the same beds in which it originated, its present limited distribution is not original, but due to subsequent movements within the body of the rock. We shall see that, as a matter of fact, the observed distribution is in many cases exactly what would result from such movements as the known laws of physics tell us must have taken place; and we may feel sure that these laws apply equally in those regions where, from one cause or another, this explanation has not yet been proposed.

Fortunately, it is unnecessary to enter on the vexed question of the origin of petroleum. The coal-miner need not trouble himself as to how the coal he mines was formed, and similarly the geologist, asked to express an opinion as to the probable value of an oil-field, is not concerned with any question of whether the oil was formed deep down in the heated core of the earth, whether it was produced by the destructive distillation of animal or vegetable matter, or whether it was formed in coral reefs, and from them floated to the shore, where it was sopped up by the sand and buried in the earth by the accumulation of fresh sediments. All these hypotheses have been proposed, besides others which need not be mentioned, for at present we are only concerned with the existing distribution of the petroleum in the rocks in which it is found.

Soon after the first great impulse was given to the petroleum industry in America, it was

noticed that the productive wells showed a strong tendency to an arrangement in long, narrow belts, and the "oil-belt" theory arose. The next step in advance was made when it was observed that these belts usually lay along the crests of anticlinal folds, and soon a class of workers came to the front who accepted the so-called "anticlinal theory" of distribution. This was a decided step in advance, for the "oil-belt" was pure empiricism or rule of thumb, and outside the particular district where a given direction was found by experience to prevail was as likely to lead to failure as success.

In the anticlinal theory the structure of the ground was taken into consideration, and a certain allowance could consequently be made for local conditions in a new district, but the assumed connection between petroleum and anticlinals was still empirical, depending solely on the fact that productive wells were mostly found along the crests of anticlinals. Seeing, then, that no reason for the connection had been given except by that brilliant, if at times erratic, thinker, Sterry Hunt, whose suggested explanation is the same as that subsequently worked out in detail by Prof. Orton, that the productive areas were not invariably confined to the crests of anticlinals, and were often wanting where, according to the cruder form of the hypothesis, they should be found, it is not surprising that many exploiters, and some geologists of ability, who had paid special attention to petroleum, declined to accept the so-called anticlinal theory.

In 1887, Prof. Orton published what appears to be the first complete theory of the distribution of oil in fields of the American, or slightly disturbed type, a theory which is not only consistent in itself, and in accordance with the known laws of physical science, but is also in agreement with the structural features of such oil-fields as have been examined in sufficient detail to allow of its being tested. The fundamental principle on which this theory is based is that, if petroleum is once introduced into a permeable stratum saturated with water, the difference of specific gravity between the two liquids will not allow them to maintain their original distribution; petroleum being the lighter of the two, will necessarily work upwards to the highest point it can reach, and, as this will frequently be along the crest of an anticlinal fold, the connection between petroleum and anticlinals is explained. This particular structure is not, however,

essential; an interruption of dip, causing the beds to lie horizontally for a short distance, and so offering a check to the upward flow of the oil, has been the cause of the principal oil fields of Ohio.

According to this theory, three things are required to make a first-class oil-field—(1) a “source” for the oil, which may or may not be the same, (2) a bed of permeable porous rock, to serve as a “reservoir,” and (3) an impermeable stratum overlying this to form the “cover” and prevent the oil from escaping. Given these, and the beds thrown into gentle undulations, the difference of specific gravity between the oil and the water contained in the porous stratum causes the former to work upwards and accumulate in the elevations of the under surface of the cover. The action that takes place is, in fact, similar, though reverse, to what happens when rain falls on an uneven surface; the water flows off the elevated parts into the depressions, and down these till an interruption of the continuity of the slope is met with, when it accumulates to form a pond or lake. So, owing to its comparative lightness, the petroleum flows upwards along the under surface of the impervious covering bed to where this bends over at the crest of the anticlinal, and again along this to the rises in the crest, where it finally accumulates. But just as ponds may be formed on the sides of a main valley by local interruptions of the regularity of the slope, whether natural or artificial, so accumulations of oil may be formed wherever there is an interruption in the gradual upward slope of the under surface of the cover; and local accumulations may be formed in minor rises, even in the troughs of synclinal folds.

Though the conditions just described are the most favourable for the development of a rich field, and are the only ones under which the prolific high pressure wells of America or Baku could have been formed, it is quite possible that considerable supplies may be obtained where a different structure prevails, where the denuded edges of the oil-bearing beds are exposed at the surface, and where there can consequently be no impervious cover. Here, again, a connection has been observed between anticlinal folds and the more abundant accumulations of petroleum; but they are by no means essentially connected with each other, and, as far as can be gathered from the published descriptions, oil is successfully worked in Galicia from

steep dipping beds, whose edges crop out at the surface.

Where such a structure is found, the first impulse would be to anticipate a gradual escape and final exhaustion of the petroleum by flowing away at the surface. Oil-springs are, in fact, found along the outcrop, and large quantities must have flowed away before the pores of the rock became clogged with the solid residues, left after the evaporation of the more volatile constituents of the oil. In this way a sort of imperfect cover is formed, behind which pressure may rise till it is sufficient to force the oil naturally from the boreholes that are sunk, though the very powerful gushing wells that are associated in the popular imagination with the idea of “striking oil” cannot be looked for.

One radical difference there is between the two types of oil-field. In the first there may be absolutely no signs of petroleum visible at the surface, and if there are, they will usually be quite insignificant in comparison with the vast quantities that may be stored underground. In the second type of oil-field, on the contrary, a large supply of oil will necessarily be accompanied by extensive “shows,” by oil-springs, and by an abundance of the products of the desiccation of the oil. The converse, however, does not necessarily hold good. Extensive signs of oil having flowed at the surface may be indications of the escape and exhaustion of the supply, as well as of the presence of large quantities underground. In such fields the geologist may be more easily led astray in his recommendations than in the first type of oil-field, and any question of the advisability of boring, and the selection of sites—if the matter is not to be reduced to the level of a mere lottery—calls for the most careful study and exercise of judgment. In oil-fields of the first-class the conditions of the problem are much simpler, and it may often be possible to approximately demarcate their boundaries, on purely theoretical grounds, after certain data have been determined by boring, for in them there will be a “base-level” of the oil, defining the limit of the field, for a bore-hole so situated as to strike the porous stratum at a lower level will only find water. The actual elevation of the base-level of the oil varies from field to field, but within the limits of each field it is, in typical instances, constant for each individual oil-bearing bed; its recognition may often prevent the useless expenditure of money on borings foredoomed to failure, and by

the gradual rise of the base-level, indicated by one well after another yielding only water instead of oil, the progress of the exhaustion of the field can be traced. In practice, however, the conditions are by no means so simple as a literal interpretation of this brief review of general principles might lead one to suppose; there are innumerable variations in the degree of permeability of the rocks, and all the structural conditions may be those most favourable for the accumulation of an abundant supply of petroleum, yet no oil-field be formed if, owing to local circumstances, there should not happen to be any petroleum present in the rocks, within the limits of what would otherwise have been the collecting area of the oil-field. The predictions and recommendations of the geologist must necessarily be of a general and conditional character. The drill and the pump are the only final arbiters of the existence, limits, or value of an oil-field, and any opinions expressed in advance of them may be regarded as of least value when most precisely and confidently expressed.

After this brief introduction, which is necessarily but an imperfect statement of a complicated subject, I will pass on to the consideration of the known petroleum fields of India. Without exception, these are situated in what is known to geologists as the extra-peninsular area, that is to say, among the hills which border the great Indo-Gangetic alluvial plain on the west, north, and east, or the further side from the rock area of the Indian peninsula. This distribution makes it convenient to take their description in serial order, commencing with the southernmost of those west of the Indus, working northwards, eastwards, and southwards, till we end up with the oil-fields of Burma. In this order the first of the oil-fields to be noticed is that of Eastern Baluchistan.*

The black mineral tar of Khattan had long been known to the natives of that country, and used by them in their rudimentary system of medicine, but the first attempt to utilise it for other purposes was when the late Sir R. Sandeman pointed out its importance in connection with the railway in course of construction from Sibi to Quetta, and obtained the appointment of Mr. R. A. Townsend to report on the best manner of utilising it.

Mr. Townsend visited the place in January,

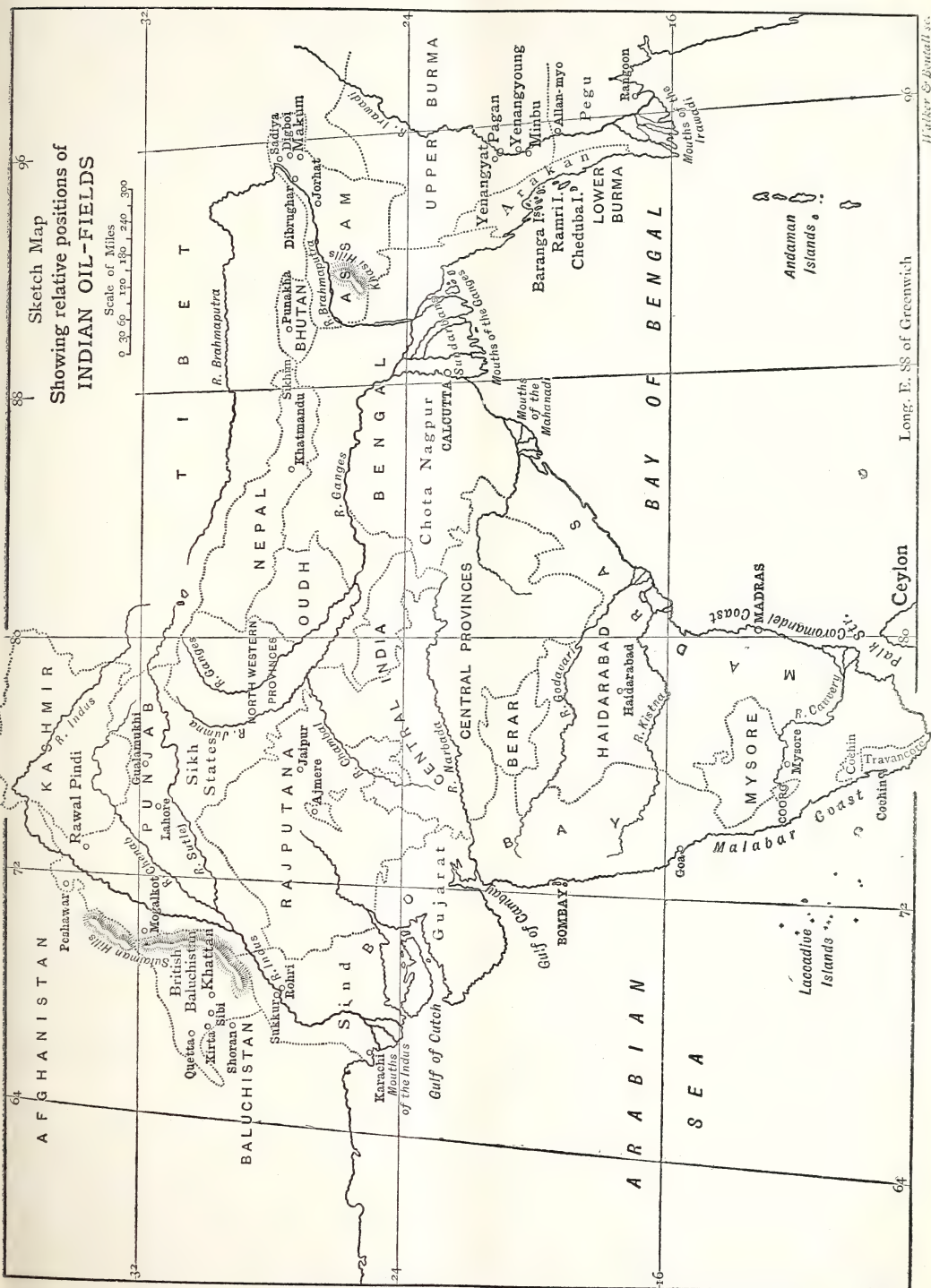
1884, reported favourably on it, was deputed to obtain men and material from Canada, and begun work in the cold weather of 1884. All through this cold weather, and well into the hot weather of 1885, work was carried on, and only abandoned on account of the sickness of the staff, sickness which, brought on by hardship, heat, and the want of pure drinking water, resulted in the death of one of the staff, and very nearly in the death of Mr. R. A. Townsend himself. The result of this first season's work was the sinking of a bore-hole to the depth of 524 feet, which found oil at 28 feet from the surface, and again at 370 and 390 feet, whence 5,000 gallons were raised in 36 hours. In the following year, a second boring was put down, and between April and July, 1886, 27,700 gallons of oil were sent to Sibi, and tried on locomotives of the North Western Railway. The result of these trials showed that the evaporative power of the fuel was 9·82 lbs. of water, against 6·91 lbs. evaporated by Welsh coal, for each pound of fuel.

During 1887 the exploratory works were continued, and 1888 opened full of hope. It was believed that the Khattan oil-field was going to supply fuel for the whole North-Western railway system up to Khanpur or Multan, and it was determined that the oil was to be used on the Khojak tunnel works instead of coal. During 1889 the sinking of wells was pushed on, but though 218,490 gallons of oil were despatched during the year, the beginning of the end had already become apparent. The heavy rains of June and July flooded the wells, reduced the output from 39,000 gallons to 2,500. By dint of heavy pumping the water was gradually cleared out, and the yield of the wells slowly improved till in June, 1890, it reached 20,000 gallons. The rains of 1890 again flooded the wells, and reduced the monthly output once more. Small quantities of oil were produced in the winter months of 1890, but by the beginning of 1891 the wells had ceased to be able to produce more than enough to supply fuel to the works at Khattan.

In October, 1889, I was sent to Baluchistan to commence a geological survey of the oil-bearing tracts, and, after spending eighteen months in examining all the region likely to produce oil sufficiently near the railway for it to be of any value, reported in June, 1891, in favour of a final trial at a place called Siah Kach, about five miles from Khattan proper, recommending that if this proved a failure, as subsequently proved to be the case

* See R. A. Townsend, "Rec. Geol. Surv. Ind.," xix. 204-210 (1886). R. D. Oldham, *ibid.* xxiii. 57-59, and 93-110 (1890), xxv. 18-29 (1892).

Sketch Map
Showing relative positions of
INDIAN OIL-FIELDS



Walker & Dentall sc.

all further expenditure should be stopped. This recommendation was adopted, and after the expenditure of over 5½ lakhs of rupees the attempt to work the Khattan petroleum was abandoned.

But though the experiment has proved a failure, it must not be rashly assumed that it should never have been tried. The oil-springs of Khattan are separated from the nearest point on the railway by 45 miles of broken and hilly country, barren, except for a few small patches of scanty cultivation on the hill tops, and supporting nothing but some scattered herds and a sparse population of cattle raiders and cut-throats. Under these circumstances, it is evident that only a rich field would repay the cost of opening out, and we shall see how far the local conditions were such as to hold out any prospect of the sufficient supply of petroleum to make the experiment worth trying.

The Khattan oil-springs are situated at the end of a great bare hog-shaped hill, formed by limestone beds bent into an anticlinal. At its western extremity the crest of this anticlinal bends downwards, and where the valley turns round the extremity of the hill is much broken up by faults and fissures, from which there flow numerous springs of hot sulphurous water, accompanied by a thick viscid tarry maltha. Here there is not a porous stratum whose pores could become clogged by inspissated oil, but a compact rock traversed by open fissures, and, moreover, with a constant stream of heated water traversing it and assisting the escape of the oil. Under such circumstances one might have predicted, what afterwards was proved, that there was no large accumulation of oil, and that after what might have accumulated in the fissures near the surface had been pumped out, nothing more of importance would be got. In spite of this, however, the shows are so abundant at Khattan that we may feel sure that an experimental boring to test the value of the oil-beds would have been recommended in any case and by any one, though the ultimate cost of the experiment would have been materially reduced had the geological survey of the country preceded, and not followed, the purchase of machinery and sinking of trial bore-holes.

Besides Khattan, traces of petroleum have been found in other localities such as Shorn, Kirta, &c., but none of these are of any importance; Khattan having proved a failure, it is certain that they would only be greater

ones, if any attempt to work them were made. There does not seem to be any prospect of obtaining oil in these hills, in sufficient quantity and sufficiently accessible to be workable.

There is, however, a locality to which attention was first drawn by Mr. H. B. Medlicott, formerly Director of the Geological Survey of India, in 1886,* the neighbourhood of Rohri, on the Indus, which seems worthy of attention. It is a noteworthy feature of the most productive oil-fields of the world—those of America and Russia—that they are found in the slightly disturbed beds flanking mountain ranges, and, as has already been remarked, usually at the highest points on the crests of the low, gently sloping anticlinal bends. Now, south east of Rohri, there rises just such a low gently sloping anticlinal of the upper nummulitic limestone. Whether the petroliferous beds of lower nummulitic or uppermost cretaceous age of Eastern Baluchistan extend so far is, of course, unknown, or if, supposing they exist, they are still petroliferous; but the structure is just such as is most favourable for the accumulation of petroleum, if it should be there; and, in 1891, I recommended, on the strength of this, that a bore-hole should be sunk where the crest of this anticlinal rises nearest to the surface, with a view to determining whether there is any important supply of petroleum here. This recommendation has been adopted, but the site selected is not such as I should have chosen; for the small convenience to be gained by proximity to the railway workshops at Sukkur it has been decided to sink there instead of on the rise of the crest of the anticlinal. The result of this choice is that though success here would point to a most prolific oil-field, failure would by no means necessarily prove that there was no oil worth working in the neighbourhood. The boring in any case is a most speculative one, but that would be a reason for not diminishing the chance of success in order to save some twelve miles transport of machinery.

In all the localities of Eastern Baluchistan the oil found is a thick black tarry maltha, containing a very small proportion of oil fit for either illuminating or lubricating purposes, or of paraffin. No chemical analyses have been made to determine the nature of the compounds contained in this oil, but its general character is such that it would have no value

* "Rec. Geol. Surv. Ind.," xix., 202 (1886).

except as a fuel. Further east, in the Sulaiman hills*, on approximately the same geological horizon a very different quality of oil has been found, which would yield 80 to 90 per cent. of illuminating oil, while the proportion of solid paraffin is so small that the remainder would probably make a very fine lubricating oil.

This locality appears to have first been brought to notice in 1889, when Mr. Broadway, District Superintendent of Police, forwarded a sample that was examined by Dr. Warden, Chemical Examiner to the Bengal Government, and pronounced by him to be a commercial kerosine of Russian origin. Subsequent analyses of authentic specimens have shown that this specimen may well have been crude oil from Mogalkot, but in 1887 this region was still inaccessible to Europeans, and the specimen was obtained through a native of the country, who may, to save himself the trouble of a long journey and feeling safe from any risk of detection, have supplied a sample obtained from the nearest bazaar.

In 1890, I visited this spot, in company of the military force sent to establish our authority over the Kidderzai clan, who had refused allegiance to the Indian Government, and reported that though the actual locality of Mogalkot did not hold out any prospects of a sufficient supply of oil to justify the risks of trial borings, it was important to undertake a detailed geological survey of the region as soon as it was sufficiently settled to permit of this, with a view to determining whether there were any other more promising localities. This has since been done by my colleague, Mr. La Touche, who traced the outcrop of the sandstone band in which the oil of Mogalkot is found, but failed to find any other oil-springs along it. As this field is of the second type described in the introductory portion of this paper, where the oil-bearing stratum crops out at the surface with a considerable dip, this fact is conclusive against the prospects of obtaining an abundant supply of oil; and in so barren a country, devoid of roads or means of communication, only a very abundant supply of the crude oil would recompense the great expense of introducing machinery and withdrawing the product.†

* See R. D. Oldham, "Rec. Geol. Surv. Ind.," xxiv., 83-84 (1892). T. H. Holland, *ibid.*, xxiv., 84-97 (1892); xxv., 175-180 (1893). T. D. La Touche, *ibid.*, xxv., 171-175 (1893).

† This locality is a good instance of the apparently capricious distribution of petroleum. There is no apparent reason why it should be produced more at Mogalkot than elsewhere along the outcrop of the oil-bearing sandstone, and though the oil-springs are situated at the crest of a slight bend of the

In the north-west Punjab there are a number of oil springs among the hills south and west of Rawalpindi. For many years past, small quantities of this oil have been extracted by collecting the exudations from the springs, and from shallow borings, and have been used in the gas works of Rawalpindi. The oil localities have been frequently visited and reported on by experts and geologists, almost uniformly in an unfavourable manner. In 1887 a concession was granted to the Punjab Oil Prospecting Syndicate, which has since been working under the personal supervision of Mr. R. A. Townsend, but though many borings have been put down in different localities, they have as yet been uniformly unsuccessful in obtaining a sufficient supply of oil to be worth working.

I do not propose to enter into a detailed account of these oil-springs, which are enumerated in the volume of the "Manual of the Geology of India," devoted to economic geology.* The character of the oil varies between a pale limpid naphtha and a black mineral tar, but the oil-field is of what I have distinguished as the second type, and the shows seem everywhere to be poor. I have, consequently, come to the conclusion, after a careful reading of the description of other observers, that there is great improbability of more than a very limited yield of oil being obtained anywhere on the western frontier of India. The data on which the conclusion is based have cost much to accumulate. It is, perhaps, too much to expect that they will prevent any further waste of money on futile experiments.

Along the foot of the Himalayas no oil-springs are known, and the only indication of petroleum is the natural gas which issues from the ground at the temple of Gwalamukhi,

stratum, which may be compared to a very open anticlinal whose axis dips to E.N.E. at 30°, and which would doubtless cause the concentration of the oil in its upward course along the line of the bending, this does not seem in itself sufficient to account for the limitations of the oil-springs. It is more in accordance with the conclusion which has been reached by observers in several regions, that the oil is of local origin, and produced from organic matter included in the beds, or in some cases formed contemporaneously with the rock, and originally deposited along with the sedimentary material. In this way the localisation of oil-springs to certain portions of the outcrop of a stratum, and their absence in other portions, is easily explained, while the actual position of the individual springs is determined by the subsequent modification in the distribution of the oil due to structural conditions and by the surface contour of the ground.

* "Manual of the Geology of India," vol. iii. Economic Geology. Calcutta, 1881, pp. 126-132, and 605, where references of earlier date are detailed. See also C. L. Griesbach, "Rec. Geol. Surv. Ind.," xxv., 106 (1892).

in the Kangra district. The only geologist* who has visited this place expressed some doubt as to the genuineness of the phenomenon, but the visit was a very cursory one, made some thirty-five years ago, when little attention had been paid to either petroleum or natural gas, and the locality would be worth re-examining in the light of the subsequently acquired knowledge.

Leaving the West, with its gloom and failures, we will now turn to the East, the region of success and promise for the future. In Upper Assam, the oil-springs have now been known for a long time; they extend 100 miles from the Singpho hills, on the east, to the Sibsagar district, on the west, and throughout this district are both numerous and abundant. The earliest attempts at exploiting this field were in 1867, when Messrs. Mackillop, Stewart, and Co., of Calcutta, obtained a concession, and sunk some wells at Makum. Altogether eight wells were put down, mostly successful, one of them being said to have yielded 82,000 gallons in the course of eight months.† The borings seem all to have been shallow, and the only reason for the abandonment of these workings appears to have been the difficulties of transport and lack of means of dealing with the oil. Nothing appears to have been done towards the development of the oil-fields for twenty years, when work was begun at Digboi by the Assam Railway and Trading Company and by the Assam Petroleum Syndicate. The former of these two associations has also been working at Makum, where Messrs. Mackillop, Stewart, and Co. were so successful, but, whatever the cause, these more recent trials were for long unsuccessful. I heard, however, just before leaving India, that a well, which flowed eight to ten barrels a day, had been struck in this locality. It is impossible to suppose that the failure of the more recent attempts as compared with the older ones made with much more primitive and imperfect appliances can be due to exhaustion of the field, and it is more reasonable to attribute them to want of skill on the part of the artificers employed, and a faulty selection of the sites for boring—more especially the latter.

The other locality, where both the associations are working, having each a grant of four square miles, is in the neighbourhood of the

Digboi and Bapu pungs. Here some ten boreholes have been put down in all, and judging from them, and from information obtained from Mr. Townsend—my own visit having been too brief to collect many details—it would seem that there are two distinct oil-bearing horizons yielding oils, which differ widely in the amount of solid paraffin they contain, if in no other respect.

To begin with the lower of these oil zones, it can be traced for a couple of miles through the forest by numerous outflows of petroleum, and the impregnation of the soil with the dried up residue left after the evaporation of the more volatile constituents of the oil. The strike of this band bends gradually round from N.N.E. to N.N.W., and the dip is high, ranging from 40° to 60°; to the west it gradually steepens, while to the east it flattens off somewhat. From this description it will be seen that the oil-field is of the second type described in the opening portion of this paper, and the very abundant shows of oil at the surface are promise of an abundant yield, a promise which has been partially fulfilled by the striking of two spouting wells, one, in January, 1892, by the railway company, the other, in March, 1893, by the syndicate. In both cases pressure was soon relieved, and the flow of the oil at the surface ceased, but this is only what must be expected in a field with the geological structure of this one, and though oil has ceased to flow of its own accord, there is abundance to be obtained by pumping.

The outcrop of the second oil zone lies some half-mile to the north-east of the first, and at a higher geological horizon. Here two wells have been sunk by the syndicate, both of which have obtained oil, but in smaller quantities than from the lower bed; the oil, too, appears to be of a different quality, containing a smaller proportion of the lighter oils and of solid paraffin, and a larger proportion of the heavier oils suitable for lubricating purposes.

It is too soon yet to speak with certainty of the future of this field. In 1892, 8,500 gallons of oil are said to have been extracted from the railway company's wells, according to a Government report, and, besides this, a large, but unknown quantity, ran to waste from the spouting well before it was got under control. This infinitesimal yield does not, however, represent the true possibilities of the field, for in the absence of any means of utilising the oil the wells were not worked. Since then,

* H. B. Medlicott, "Mem. Geol. Survey, India." III., pt. ii., 146 (1864).

† T. W. H. Hughes, "Rec. Geol. Surv., India." VII., 55-58 (1874).

however, a refinery has been established at Dibrugarh, and we may hope to see Digboi and Makum established among the productive oil-fields of the world.

These ventures are important not so much from the point of view of their individual success or failure as for the promise they hold out of greater success elsewhere. The localities were not selected after extended examination, as being the most promising, but merely on account of the fact that they were close to an open line of railway, and consequently easy of access. But Mr. Mallet's report* enumerates twelve other localities between Digboi and the Disang valley, where there are abundant oil-springs, and in this tract it is incredible that there will not be localities where the conditions are more favourable for the accumulation of large stores of petroleum than at Digboi, and the yield will be larger in sufficient degree to more than pay for the extra expense and delay in bringing in machinery. At the time Mr. Mallet's exploration of this region was carried out, the laws that govern the distribution of petroleum had not even begun to be understood, and even the most sanguine had not anticipated the important part it has played, and is destined to play, in the advance of civilisation. His attention was consequently directed more particularly to the coal-fields, and many of the oil-springs were left unvisited, while, as regards those that were seen, the geological details recorded are not such as enable an opinion of their relative values to be formed. The country was then, and is probably still, too inaccessible for the oil-fields to be workable, but within three years at the outside the Assam Bengal Railway will run not far from the foot of these hills, and we may then look for a rapid opening up and development of the coal and petroleum fields of Upper Assam, which are unsurpassed, both for quantity and quality, in the Indian Empire.

The westerly extension of this oil-field has not been traced, but it is known that petroleum occurs in rocks of the same age on the southern margin of the Khasi and Garo hills. I have myself seen one of these localities where there was an abundant discharge of gas, accompanied by a light mineral naphtha, along the outcrop of a highly inclined bed of sandstone. There can be little doubt that, after the richer fields of Upper Assam have been opened up, and the men and material requisite are to be

obtained locally, an attempt will be made to work this oil. At present, however, the promise is not sufficient to justify the heavy expenditure inseparable from a pioneer industry.

On the west coast of Burma petroleum is known to occur in the Ramri and Cheduba islands*, where attempts to work it on a large scale have been made by two companies, the Arrakan Oil Company and the Baronga Company. The produce was too small to justify the continuance of operations on a large scale. Moderate amounts of oil are still obtained annually from open wells, but I have not been able to obtain statistics of the production, which is insignificant in importance.

Lastly, we have to consider the newly-acquired province of Upper Burma, where the only productive oil-field of the Empire is situated. The original discovery of the oil-field of Yenangyaung is lost in the mists of antiquity, but the highly-picturesque version which passes current at the present day relates how in January, 1099, the King Alaungsithu Mingyi of Pagan, attracted by the accounts he had heard of its marvels, especially a wonderful spring of surprisingly sweet-scented waters, visited the town now known as Yenangyaung. Unfortunately for themselves, some of his consorts had also heard of this wonder, and determining to visit and see it for themselves, were so entranced by the exquisite odours exhaled by the water that they forgot to return at nightfall. Next morning the king instituted a search for his truant wives, and finding them seated on the banks of the scented pond, oblivious of their duties to their lord and master in the enjoyment derived from inhaling its perfume, he, in the plenitude of his Oriental power, ordered their immediate execution, and, in virtue of his miraculous powers, deprived the spring of its dangerously-attractive properties, deciding that in future the pleasant perfume should be changed to the repulsive stench of petroleum, whence the place has ever since been known as Yenangyaung, or stinking water creek.

Reduced to plain language, this legend would seem to indicate that the petroleum was discovered some 800 years ago, but it is far from improbable that in mixing up the discovery of the field with mythical incidents, its antiquity has been exaggerated. The petroleum industry of Upper Burma is, however, of considerable age, for as far back as 1759 it was recorded by Captain Baker that 200 families

* "Mem. Geol. Surv. Ind.," XII., pt. ii., 269-363 (1876).

* F. R. Mallet, "Rec. Geol. Surv. Ind.," xi., 188-207 (1878)

were "employed in getting earth oil out of pits, some five miles in the country," from Yenanyaung, thus showing that the industry was well established nearly a century and a half ago.*

Until 1887, the only means of working the oil in use were square shafts rudely lined with timber, in the bottom of which the oil collected and was laboriously drawn up in earthen vessels, by means of a rope passing over a rude wooden framework at the mouth of the well, and though many deep borings fitted with steam pumps are now at work, the greater part of the oil is still produced in the older and more primitive manner. In course of time, as the upper oil sands, which alone can be tapped by the dug wells, become exhausted, the drilled wells will doubtless come to be the only source of supply.

In geological structure the Yenangyaung oil-field is very simple. The strata are bent into a well marked anticlinal, whose axis trends N. 30° W.; at the crest of the anticlinal the beds lie horizontally, and for a short distance on either side the dips are very gentle, increasing gradually till, at half a mile on either side, the dips are 30° and over. In a north-westerly and south-easterly direction the axis of the anticlinal slopes gently downwards, the fold itself flattening out, and it is just at the highest point in the crest of the anticlinal that the oil is found.

The oil-field, consequently, belongs to the first-class, though some complication is introduced, as compared with the American examples, by the fact that the oil sand is not one single homogeneous band, but consists of beds of sand, separated by clays and shales. The analogy of other similar deposits makes it certain that the beds of sand and shale are not continuous, but lenticular in form, coalescing with each other irregularly. The consequence of this is, that pockets would be formed at the crest of the anticlinal, in which the oil would collect, and be prevented from rising to the top of the sandstone by the bands of shale running through it. This seems to be the only way of satisfactorily accounting for the alternations of oil and water recorded in the logs of the borings which have been put down.

Leaving this, which is more or less matter of conjecture, it may be noted that the limits of the Yenangyaung oil-field have been practically defined on all sides but one.

The actual oil-bearing territory is about 3½ miles long by half a mile wide; at either extremity are situated the Burmese villages of Twingon and Beme, while in between them is a tract of country which the native workers believed to be barren, but which has been proved by Messrs. Finlay, Fleming, and Co. to be as fruitful as the land on either side. To the south of Beme the prospecting operations of the Upper Burma Oil Syndicate have shown that there is no petroleum. On either side of the axis of the anticlinal it has been found that the oil-bearing territory does not extend beyond the region of low dips near the crest of the fold, and to the north of Twingon it is very doubtful if the productive area extends to any distance. This is the only direction in which the limits of this oil-field have not been determined. In so far as can be judged from analogy and the experience of other fields, no great extension in this direction can be looked for.

Some fifty-four miles N.N.W. of Yenangyaung the oil-field of Yenangyat is found on the right bank of the Irawadi. As at Yenangyaung the strata are bent into an anticlinal, but the bending is much sharper, the beds on the eastern side being vertical or nearly so, and the field may be more properly looked upon as belonging to the second type. The produce of this field is small as yet, and its future difficult to judge of. It may, however, be noted as an interesting point that the oil is under sufficient pressure to allow it to flow naturally at the surface in a suitably-arranged bore-hole.

A third oil-field in Upper Burma which may be mentioned is that of Minbu. The mud volcanoes of this district have frequently been described. As in Cheduba and Ramri, petroleum is poured out along with the mud and collected in small quantities. Some half-hearted attempts to test this region as an oil-field have been made, but not enough is known to enable any opinion to be formed of its future prospects.

Having passed in review all the known oil-fields of the Empire, and described their present state of development, I will now attempt to justify the second part of the title of this paper.

As has already been mentioned, there is little to hope for from the petroleum of the Western fields, and it is very questionable whether they are destined to have a future at all. In the East, however, things are dif-

* Noetling. "Report on the Petroleum Industry in Upper Burma." Rangoon, 1892, p. 2.

ferent. Upper Assam is known to contain an extensive area of richly petroliferous rocks, whose future we may be allowed to look at in a hopeful manner. As yet this area has only been tested at two points, both chosen solely on account of their nearness to an open line of railway. The greater portion of the region is still too inaccessible for its exploitation to be commercially possible, but it will soon be skirted by the Chittagong-Assam Railway, now in course of construction, and when this is completed it seems possible that the Assam oil, with all the advantages of water carriage, will be brought down to Calcutta at a price which will enable it to compete with the imported article.

In Cachar and Arakan the prospects are much less bright; in these regions only a moderate development of the industry can be looked for, while even this will have to wait till the development of more favoured regions has introduced men and materials into the country, and converted a pioneer into an established industry.

Finally, we may look for a great expansion of the petroleum industry in Upper Burma. The oil-fields of Yenangyaung and Yenangyat, both of which derive their oil from beds of the same age, and the occurrence of oil on the same horizon at Minbu and in some isolated localities to the north of Yenangyat, show that the oil is spread over a very large area, in which it is almost certain that other fields will be found. Moreover, in this area the rocks are to a great extent only moderately disturbed, and thrown into well-defined anticlinal and synclinal folds, so that the oil-fields will probably belong to the first type, and consequently, are likely to yield considerable supplies of petroleum.

Such, briefly stated, appear to be the possibilities of the future, but how far these possibilities will be fulfilled depends so much on the policy adopted by the Government, that it is impossible to omit all reference to what has been done in the past and to what appears to be required in the future.

In Baluchistan the experimental borings were carried out by the Government itself, and this course was here justified by the fact that the supply of petroleum was required for, and would almost solely benefit, the North-Western Railway, which is the property of the Indian Government. No other boring operations have been directly undertaken by the Government, though in the case of one syndicate a fixed sum was allowed on every exploratory boring

which proved unsuccessful in finding workable quantity of oil.

In Assam nothing has yet been done, beyond the grant of two separate concessions for the working of petroleum, but in Burma a long strip of country between Yenangyaung and Yenangyat has been surveyed on the scale of 16 inches to the mile, and demarcated into blocks of one mile square, which have been offered to adventurers on terms published by the Burma Government. The same has been done in the neighbourhood of Minbu, though no detailed geological survey has been made, except of a small area in the south of the Yenangyaung oil-field.

As regards the future, the two principal things required seem to be, firstly, a survey of the areas in Burma and Assam in which oil is likely to be found. This would not need to be on a larger scale than two inches to the mile, nor need there be any demarcation of blocks; but the survey should be geological as well as topographical. The publication of these maps, with the accompanying descriptions, would put the adventurer in possession of all the information procurable in advance of actual boring operations, and would guide him to the places most suitable for the inception of his venture. The second is the promulgation of a set of rules for the grant of mining concessions, which will prove acceptable to would-be applicants, without sacrificing the general interests of the country. This is the more difficult task, for the adventurer—and I use the word in its original sense, without any reference to its acquired implications—is apt to forget that, while he must look to his own interest, the Government have to act as trustees of the country at large and of posterity. The conflict between the interests of the one party and the duties of the other will constantly lead to mistaken judgments on either side, which render it difficult to steer accurately the middle course between an undue favouring of individuals on the one hand, and a drag on the progress and prosperity of the country on the other. Such rules, I believe, will shortly be published, and we may hope that the near future will see a considerable increase in the production of petroleum in Burma and Assam, an increase which will enable these provinces to provide for their own consumption, and in part for that of the rest of the Empire, though there seems no reason for anticipating that India will ever rank with Russia and America among the great petroleum exporting countries

of the world. For the present this must remain a hope. So little is known of the geology of these regions that it would be rash in the extreme to prophecy, but what is known is enough to hold out a prospect of success, and an inducement to the acquisition of further knowledge.

In connection with the foregoing account the following statistics regarding the imports into India, and into the provinces of Assam and Burma, will be of interest :—

TOTAL IMPORTS OF MINERAL OIL INTO INDIA.

	Kerosene.		Other kinds.	
	Gals.	Rs.	Gals.	Rs.
1887-88.....	30,200,042	1,21,68,173	1,221,517	5,76,591
1888-89.....	38,285,559	1,76,79,373	1,666,326	9,33,430
1889-90.....	51,839,400	2,38,66,839	1,550,758	9,21,426
1890-91.....	52,561,279	2,26,25,291	1,673,978	9,96,901
1891-92.....	55,601,220	2,20,09,659	2,601,220	16,71,746
1892-93.....	64,409,305	2,51,58,735	2,676,663	17,43,905

In 1891-92 the value of mineral oil imported into the—

	Rupees.
Brahmaputra Valley was ..	7,33,295
Surma Valley.....	5,38,531

Total value of Assam imports, 12,71,826
being equivalent to 2,428,576 galls.

The imports into Burma were 2,428,576 gallons, of the value of Rs. 10,53,152. I have no exact statistics regarding the amount of kerosene manufactured in Burma, but have been informed that, in round numbers, it was 2,200,000 gallons, or less than half the total consumption of the province.

DISCUSSION.

Mr. BOVERTON REDWOOD said this paper was of great value, because what, in his opinion, was most to be feared in connection with the development of the petroleum fields of India, was the encouragement of ill-directed enterprise. He had pointed that out in a paper read in another place nearly four years ago. In the interests of the Empire it was to be hoped that the work of petroleum exploration and development would not be attempted without a full appreciation of all that it involved. It was in the highest degree important that this work should for some time to come be carried out under skilful, energetic, and—above all—experienced, management; and ample means should be available. On any other

basis it was highly probable that much money would be wasted, without obtaining satisfactory results, or even conclusive negative evidence. Much disappointment and discouragement would thereby ensue, and the development of the oil-fields would be considerably retarded. There was a distinct danger in too sanguine an estimate of those oil-fields being taken, and he was, therefore, very glad to hear it stated that the value of a geologist's opinion on any oil-field was in inverse proportion to the confidence with which it was uttered. In the paper to which he had already referred he had said much the same thing. But while the test of the drill was the only satisfactory one, it was obviously very desirable that the work of geological survey should be actively prosecuted, and he hoped that a gentleman who had exhibited so thorough a grasp of the subject would be personally identified with this work. The Indian Section of the Society were much indebted to Mr. Oldham for this instructive paper.

Mr. S. J. WILDE said he understood Mr. Oldham to say that the oil regions of Burma were all on the right bank of the Irawadi, and that their development would be aided by the new railway; but that was on the left side of the river, and, therefore, he did not see how it would be useful in bringing the oil to market. He did not hear any reference to the oil of Rangoon, which had been worked for many years, some of it he believed having been used by Price's Candle Company.

Mr. OLDHAM said the oil-fields of Upper Burma were on the right hand of the Irawadi, but a good distance from it at the foot of the hills, and the railway would come up to the foot of those hills. So far as he knew, the only workings actually carried on in the Burma oil-fields were those of Messrs. Finlay, Fleming and Company, at Yenangyaung. Rangoon oil was merely a commercial name, and he believed that all other firms concerned in the trade merely purchased the native product.

The CHAIRMAN said they had all listened with much interest to this paper, which would form a most valuable addition to the information at the disposal of the public in regard to the oil-fields of India. They could not but regret that Mr. Oldham's researches had led him to the conclusion that India would not be likely to compete in any great measure with Russia and America, but they would hope that his anticipations of the out-turn of Assam and Burma might be fully realised. At the same time they would agree in his suggestion that a thorough survey should be made of the areas likely to be productive in those countries, and that the suggestion would commend itself favourably to the Government of India. Should this be the case, he sincerely trusted that that work would be put into the hands of Mr. Oldham. He concluded by proposing a vote of thanks to him, which was carried unanimously.

FOREIGN & COLONIAL SECTION.

Tuesday, January 23, 1894; LORD COLCHESTER in the chair.

The paper read was—

MOROCCO, AND ITS RACES.

BY CHARLES ROLLESTON.

The steady march of events towards the close of the 19th century indicates, in unmistakable characters, one special phenomenon, namely, the rapid and permanent triumph of enlightenment over barbarism.

In former epochs of our world's history, we see that, from time to time, great empires took their rise, and, with their own peculiar forms of civilisation, nurtured in soft, semi-tropical climates, became the seats of culture and refinement. But each one, after a longer or shorter period of glory or voluptuous splendour, declined in turn, and, owing to various causes, slept the sleep of national decay, having within it the germs of some unsound principle, unable to stand the test of time. On the other hand, it was amidst harsh climatic conditions and rugged adverse forces, in mists and cold, that the cultivated thought of Europe developed painfully and slowly, yet, owing to the very intensity and length of the struggle, it became invested with a force of intelligence, with a special vitality, which now enables it to send its branches throughout the habitable globe, and is rousing into active life the qualities which, far back in the vista of time, constituted the greatness of the nations of antiquity. China, like a dried-up mummy, is throwing off the bandages which have enveloped her for ages. Japan is rapidly, perhaps too rapidly and too slavishly for the happiness of her people, adopting the manners and customs, even the dress and architecture of the West. Persia, Turkey, India are becoming cosmopolitan, at least, to outward appearance; and our generation can now only expect to catch a glimpse of the snow-white turban, the haik, and the kaftan, which, with much more that is natural, graceful, and picturesque, must shortly pass away, as in a dissolving view, before our machine-like modern institutions, stiff, common-place, and practical, like our costume. The present condition of the Moorish empire furnishes an instance of a State which, once having attained a considerable degree of eminence, has lapsed into a phase of comparative decrepitude from which by no internal national

effort it can ever hope to rise. In the 10th and 11th centuries, when Mohammedan civilisation, as it existed in Spain and Africa, was at its zenith, Morocco had its universities, where the sciences were taught, and from which learning was diffused in a manner then unknown in Europe. A large Mediterranean commerce had been developed, and the country was studded with towns and villages, amongst the ruins of which families of nomadic Arabs, at the present day, lazily feed their flocks, too apathetic even to look with interest on the silent evidences of a former state, the vestiges of wealthier and better times. Uncultivated wastes now take the place of rich plantations, where under a genial sun, and in a generous soil, the sugar-cane, the vine, the cotton plant, with the varied fruits and products common to semi-tropical regions, grew to perfection under the careful industry of the Moor, and an intelligent, prosperous people has dwindled down to a remnant consisting of some five or six millions, oppressed and discontented under a wretched and effete government.

Several causes contribute to attract attention to Morocco at the present time, much more having become known of the empire within the last few years, than formerly. It has now been recognised that the country possesses enormous mineral resources, that it has one of the healthiest and most agreeable climates in the world, and a soil of unusual fertility. Amongst the mountain ranges and hill districts there is scenery unequalled in grandeur and natural beauty; while the land, though yet hardly known, is replete with interest for the man of science, the explorer, the sportsman, the antiquary, and the artist. The rapidity and ease of steam communication have brought the shores of Western Barbary within five days' journey from England, within three hours from Gibraltar. Several nations have begun to view Morocco as a possibly valuable appendage, and a source of future colonial opulence, thus raising up in the horizon of politics a new and distinct Moorish question. Whatever may be the ultimate fate of the empire, one thing is pretty certain, its present condition cannot be maintained much longer: the territory is too near civilisation, and its inevitable destiny points to its being opened up by the energy of Europe. The search after sunshine, coupled with the present feverish race for wealth, will doubtless impel many to find a temporary home, or a field for future exertions, in the dominions of Muley Hassan.

Mauritania Tingitana, the present empire of

Morocco, was, while a province of the Romans, known by them, on account of its agricultural wealth, as the granary of the Imperial City. It was towards the close of the 7th century that the Arabs, in their career of conquest, penetrated the north-western portion of Africa, and eventually succeeded in establishing amongst the inhabitants a totally distinct set of laws, a language, and a religion; as a consequence, the established and national faith becoming Mohammedanism. I may here state that the Moslem belief, and the social system observed by its votaries is, according to my experience, after several years' residence amongst them, perhaps the most purely democratic in the world. In Mohammedan countries the simple soldier, the huckster, the barber, or the freed slave, may, and often do, fill the posts of the highest public functionaries; the slave girl may become, and sometimes is, the mother or the wife of the pacha. Once within the pale of Mohammedanism class distinctions to a great extent fade away, and the institutions of feudalism are almost unknown. It is not difficult to understand that when men gifted, it may be, with natural ability of some kind, but untrained and uneducated, are placed in the position of administrators, they are found wanting in a sense of *morale* and responsibility, while peculation and intrigue go hand in hand, giving rise in time to the grossest abuses. Thus Mohammedanism has proved itself to be incompatible with an enduring high state of civilisation; it not only lags behind, but wherever it has passed it has left a ruin behind it. The reception of the new doctrine in North Africa, and subsequently in Spain, was favoured by several causes, to comprehend which it may be necessary to glance at some aspects of that creed which was destined to play such an important part in the history of a large portion of the human race.

Mohammed may be said to have commenced his active career about the year 612 of our era, although the Moslems date theirs from the time of the Hegira, or flight of the Prophet from Mecca to Medina, which occurred A.D. 622. At that time Christianity, which had begun to spread rapidly in Europe, had obtained a very partial success in Asia, and was contending somewhat feebly with Paganism for a mastery over the human mind. Then the Mecca Arab, illiterate, unknown, unaided, became the leader of a new sect, and by means of the scimitar and the Koran boldly proclaimed the worship of the one God.

Mohammed was an orphan from his early childhood; his only knowledge of the world was such as could be derived from the narrow circle of an Arab tribe and some caravan journeys in Syria and Palestine; education he had none, and he commenced life as a religious adventurer, with a fortune of five camels and a slave girl.

At first he encountered almost overwhelming difficulties. Narrowly escaping death by violence, and attended only by a few enthusiasts like himself, he never ceased to preach the unity of the Godhead, and at last achieved success. He is said to have been subject to epileptic fits which affected his mind, and his utterances were supposed by his followers to be of divine revelation; unable to write, his words were taken down by his disciples on palm leaves and shoulder-blades of mutton, which, thrown at random into a chest, were collected years after his death, arranged without order or regularity by one of his relations, and formed into a book, a book which now soars into incoherent rhapsody, now descends to vapid nonsense, in which childish fable, and passages suggested by the Jewish Scriptures are blended together with a confused jumble of some excellent moral maxims, precept, and declamation, which has neither connection nor narrative. Such was the man, and such was the book which founded a religion that has now endured for more than twelve hundred years, and which to-day embraces 160,000,000 of adherents; which successfully encountered the philosophical opinions of Confucius in China, the mystic systems of Paganism, with their ancient origin, their obscene rites in India, and the gross Fetish superstition of the African negro. All these succumbed to the teaching of Mohammed, who dissipated the religious tenets of the most distant nations, as his followers scattered their armies.

Indeed, it is impossible not to be struck, alike with the marvellous success of the new belief, as with the facility with which it united nations of the most opposite characters, professing the most diverse creeds. As the tide of conquest rolled on, Mohammedanism seemed only to have to make itself known to obliterate—more or less—all other faiths with which it came into contact; for it is a religion which, spreading with a rapidity that has no parallel in history, has extended over an immense part of the habitable globe, which, but for the result of one battle,* would probably have swept over

* The Battle of Tours, A.D. 732.

western Europe, and which did extend from southern India to the borders of Siberia, from the confines of China to the shores of the Atlantic, and from the slopes of the Atlas Mountains to the slopes of the Pyrenees.

Viewing the stupendous results which were achieved by the doctrines of such a teacher as we have described Mohammed to have been, it becomes at once apparent that the rise and progress of his precepts must have been due, not so much to anything in the character of the man himself, as to some peculiarly attractive principle, embodied in the religion he taught, which rendered it highly acceptable to a large portion of the human race.

Mohammedanism is a faith which exalts charity—the most easily exercised of all virtues, as the one most pleasing to the divinity, whilst a considerable license is permitted to the animal passions, and, at the same time, the doctrine of predestination most rigidly inculcated by it forms an excuse for the apathy and laziness so common to Oriental races. The successors of Mohammed gave with the utmost liberality to their followers the lands and worldly goods of those who might chance to differ from them in religious faith; the true believer was enjoined to take possession as soon as he was able, and to retain it as long as he had the power to do so; indeed, the most pious Mussulman found little difficulty in persuading himself that to slaughter an infidel and confiscate his goods, to send his son to the slave bazaar, and to take his daughter to the harem, were acts which, while they redounded to his own comfort and happiness on earth, by no means endangered his spiritual interests in the world to come.

The future life promised by Mohammed to his followers did not consist of a shadowy existence amongst the clouds, like the heaven believed in by so many Christians. On the contrary, whilst to the orthodox Paradise is not difficult of access, its pleasures were to be of a substantial nature, and were well adapted to the minds of those whom the prophet addressed. Of all the different varieties of the human race, the Arab is perhaps the most imaginative and the most poetical; to him the promised joys of heaven were real and tangible. In his fancy, free from the hot wind and drifting sand of the desert, he beheld stretching before his eyes the cool and verdant plains of paradise; he saw the palm tree and orange grove laden with fruit; but he also saw under their shade groups of white-robed odalisques, each one a maiden of

exquisite beauty, regarding him as her only lord and master. Living in a palace surrounded by a lovely garden, its flowers were before his eyes while their perfume gratified his senses, the songs of the bulbul and the nightingale sounded in his ears, and he pictured to himself a species of celestial Alhambra, through the courts and galleries of which he wandered, amidst a silence broken only by the splash of the water in the fountains and, the voices and the laughter of his concubines. While music, beauty, poetry, all that can charm the eye and gratify the most æsthetic taste, lent their aid to delight and fascinate him in his enchanting home, and celestial houris were to be his slaves and companions, he was gifted with everlasting youth. Such were the material pleasures foretold by the Prophet to his followers, and it must be said his system of religion was well in accordance with the ordinary form of Asiatic thought.

Mohammedanism, like every other institution in Morocco, has undergone a gradual process of decay, and the faith has become mingled with gross forms of superstition. Nominally, any species of idolatry is forbidden; and, so far is the iconoclastic sentiment carried, that the followers of the Prophet consider it a crime to make the likeness of any living creature; thus, the Mussulman cannot represent, by painting or sculpture, the forms of a human being or animal; and the prohibition extends, amongst the orthodox Mohammedans, even to the delineation of trees and flowers. As a consequence of the above, the Moslem artistic talent applied itself to that particular kind of decorative art known amongst us as arabesques, and which, being exceedingly elegant and tasteful, is very applicable to the interior of even European houses. If, however, walls, ceilings, curtains, carpets, and tapestries show arabesque patterns, although the effect is good, it is accompanied by this drawback—there must be no mixture of European art, for the two styles are so completely different, that the result is a painful and absurd incongruity. If the Mohammedans show deep-rooted aversion to the worship of images, religious sentiment amongst them tends strongly towards the adoration of a class of person known as Seyuds, or holy men. These persons often gain a widely-extended reputation for holiness, on account of some eccentricity of conduct, and their supposed sanctity is considered quite compatible with their being, I think I may say, in most cases

men of dissolute, or even most infamous character. Sometimes, on the other hand, they are persons of unsound mind, of weak intellect, or idiots, similar to the *crétins*, so often to be observed in Switzerland, and unfortunates of this description are regarded with peculiar reverence as they are supposed to be under the special protection of the Divine Being. The memory of Seyuds long since dead is also revered, and Morocco is widely strewn with the tombs of those men, to which the Moors resort continually for the purpose of prayer, of invoking the saint in times of trouble, or in some cases when the deceased saint has obtained a reputation for extreme holiness, to claim sanctuary; the walls surrounding the tombs forming a refuge in which criminals or debtors are safe from arrest by the Sultan's officials.

Owing to the geographical position of Morocco and to the peculiar distribution of its mountain systems, elevated plateaus, and low lands, the climate ranges between that of the north of Scotland and the plains of India. The products of the country also are varied, and under a good administration would be very valuable. Rice, cotton, hemp, and silk are produced, but owing to the insecurity of property the industries languish and only exist for home consumption. During the middle ages the Arabs introduced the sugar-cane, and the plant would thrive extremely well in the southern provinces, but the crop being highly profitable exposed the owners to extortion, and the former rich sugar plantations have become things of the past. The soil and climate of most portions of the empire are well adapted to horticulture, and but for the almost prohibitive export duties a trade would arise capable of supplying in a great measure the fruit markets of Europe. The produce is abundant and varied, consisting chiefly of oranges of various kinds, lemons, dates, peaches, plums, apricots, grapes, figs, pomegranates, mulberries, and olives.

It may be seen from the above description that Morocco is a fruitful and flowery land, it is also teeming with mineral wealth and rich in its agricultural products. The state of decadence into which the country has fallen is simply due to the nature of the administration, which does not fulfil a single function, duty, or responsibility of a Government, and its system may shortly be expressed in two words, oppression and extortion.

On my first visit to the Moorish empire, several years ago, I was at once struck by the

fertility of the soil, the magnificence of the scenery, and the delicious influence of the climate, which is at the same time balmy, soft, and highly exhilarating.

Indeed, in modern times it has been called the garden of North Africa; but also the China of the West, on account of the exclusive policy of its rulers. I may here observe that the Moorish Sultan, like a great many of his subjects, claims descent from the prophet Mohammed; and as every person of this race is distinguished by the title of Shereef, the Moorish potentate is always spoken of as his Shereefian Majesty, and his court as the Shereefian Court.

The territory claimed by the Moorish ruler is somewhat larger than France, but over wide districts his authority is merely nominal, and this remark applies chiefly to certain mountain ranges and other inaccessible portions of the country, the inhabitants of which, while they speak of the Shereefian monarch as Seedna (our lord), decline to pay him any taxes or to be governed by officials of his appointing.

Beginning at a distance from the coast—speaking roughly, of about ten miles—the land rises gradually, and forms a vast central plateau sloping towards the Atlas, and traversed by numerous hill chains of various degrees of altitude, varying from 2,000 feet to about 8,000 and 10,000 feet. There are two ranges, however, which, in their height and grandeur, surpass all the others, and these are the Reef Mountains, which, commencing about 20 miles east of Tangier, extend for about 180 miles along the coast of the Mediterranean. The second range, which is superior in length and height, lies to the south of Morocco, and is known as the Atlas. Now, regarding the Reef Range, there is a singular and interesting fact which is not generally known in this country, and it is this, that until about eight years ago, the interior of the Reef country was one of the few remaining portions of the habitable globe, relative to which no knowledge whatever existed of their having been explored by civilised man. True, the inhabitants of this tract of country were in former days, and even so lately as in the first half of this century, known as daring pirates. In the creeks along the coast lurked swift cutters which, manned by Reefians used to issue forth from time to time and prey upon trading vessels in the Mediterranean. Now and then captured mariners may have been carried off to the mountains and kept as slaves, but if any of them ever made their escape or were ransomed, no

authentic record has been preserved of the interior of the Reef country.

Before proceeding further in my description of this locality, it may be well to give some account of its inhabitants. They are generally, but erroneously, styled Reef Arabs. They, however, have no affinity whatever with the Arabs, and are really representatives of the great Tuarick race, which is considered, in remote times before the dawn of history, to have inhabited all North Africa. The origin of this race is absolutely unknown; they speak a peculiar dialect, are very warlike, and live in separate tribes; they inhabit also the great chain of the Atlas, in the southern part of the Empire; they are very averse to foreigners penetrating into their country, and are there known by the generic name of Berbers.

The low-lying part of Morocco is inhabited by a very mixed race; the Phœnicians made some settlements there about 1,000 years before Christ, from which time the definite history of the country commences; subsequently, it fell under the dominion of Rome, about 150 years before Christ, and was conquered by the Vandals, who held the territories for about 90 years. It was then re-conquered by the Romans; afterwards, towards the close of the seventh century, the Arabs poured into the country in hordes, from which time their rule has continued until now.

It must be remembered that, at the epoch of the Arab invasion, Rome had become Christian; and Christianity, in a primitive form, was the religion of Morocco, curiously enough, extending through the Atlas and Reef ranges among the tribes, who adopted the religion of the foreigner in their mountain homes, from which they so carefully excluded the foreigner himself. Thus, in turn, Phœnicians, Carthaginians, Romans, Vandals, and Arabs settled in Mauritania, but none ever penetrated the Reef country. The inhabitants came down to the plains to sell produce; for they cultivated the fertile valleys, and pastured their flocks and cattle along the slopes of their mountains, but, even if willing, none of them dared introduce a stranger to their native villages.

In modern times, in the year 1865, a French nautical expedition, conducted by Monsieur Vicendom and Monsieur Kerhallet, sailed along the Reef coast, in order if possible to obtain reliable information; they touched at a few points, but found that to penetrate the country without a large armed force would be totally impossible, so the Reef remained still

as much a sealed book as before. It was, however, not destined to remain so permanently, and knowledge of the interior was obtained in a manner hardly to be expected. About twenty years ago there resided at Tangier a Moorish noble, known as the Shereef of Wazan, Wazan being the name of a large landed property he possessed in the interior. He was a cousin of the Sultan, and was supposed to have inherited from his ancestor, the prophet Mohammed, a special degree of sanctity, endowing him with supernatural powers, not accorded to the other members of the great Shereefian family. This noble happened to fall in love, at first sight, with a young English lady, who was at that time residing with one of the foreign families in Tangier, and having proposed for her she shortly afterwards became his wife. The English lady was then known as the Shereefa, and in due time gave birth to two boys, who are known as Muley Ali and Muley Mohammed, both being educated as strict Mohammedans. The Shereef, I may here say, did not require his wife to adopt native dress, or enter the seclusion of harem life; and she visited as before amongst the European families of the town, often being accompanied by the Shereef himself. Some eight years ago, the Moorish noble being unwell, was recommended by his physician to visit the hot mineral baths of Taafna in Algeria, and proceeded there. On his course of the water being finished, he was asked to use his good offices in settling some tribal disputes within the Moorish frontier; and, agreeing to do so, he elected to return to Tangier by land through the Reef country, the inhabitants of which placed no obstacle to the passage of a man of such sanctity through their territory. The Shereef's party, accompanied by a body of servants and attendants, travelled with their tents, which, with their baggage, were transported on mules and pack-horses, and the idea struck the Shereefa that, as she rode through the mountains, she might take notes, and gather information regarding a land which had never as yet been explored by civilised man. It was, therefore, somewhat discouraging that the lady, at the very beginning of her journey, should be told by her Moorish lord and master that, during the expedition, she must on no account be seen writing on any subject whatever; that she must not be seen even with a pencil in her possession; and that if the Reefians suspected any of the party were taking notes, their further progress would be

arrested, and they might be obliged to retrace their steps. On hearing this, the Shereefa felt constrained to trust to her observation and memory, and on her return she gave me an account, which was shortly afterwards published in the *Globe*, from which I quote the following :—

“ Among our *entourage* was one European, a member of the French Geographical Society, who desired to explore the Reef country. Shortly, however, before our party started from Melilla, his further progress was unexpectedly arrested, as a message arrived from one of the mountain chiefs, to the effect that the tribes could not allow the Christian to pass through their territory. He had been seen, it was said, taking some photographs, and this aroused the suspicion of the natives, who are ever on the alert to prevent inquisitive Europeans from getting information regarding mines, &c. Leaving Melilla, we struck into a vast mountain system, and were fairly in the land of the Reefians, from this time travelling each day and halting merely for the night. I saw nothing of the appearance of a road during our entire journey ; but we passed along a narrow track, sometimes leading over the top of majestic mountain ranges, at others, lying close to the seashore : the slopes of the hills were in many places covered with dense brushwood, in others, there were abundance of olive groves, and sometimes the hillsides were wooded by the arar tree, a species of pine having a strong but agreeable perfume, and said to be well adapted for cabinet work, though hardly known in Europe. I also noticed quantities of fig, walnut, almond trees, and vines. The scenery was truly magnificent as we wended our way through the mountain passes, when every mile seemed to present us with landscapes more romantic and beautiful than the preceding. The fertile valleys were studded with Reefian hamlets, surrounded by their gardens, rich in the foliage and flora of North Africa, while at times the track led over high ground, from which, to our right, we had extensive views of the deep-blue Mediterranean, lying calm and undisturbed by a ripple beneath us, and to our left were grand mountain chains which, towering up one behind the other, showed the most lovely effects of light and shade ; their craggy summits standing out clear and distinct against the bright azure sky. The lower slopes were sometimes wooded with park-like trees, relieved by open glades, which were covered with a profusion of wild flowers, showing every diversity of hue as a brilliantly variegated carpet. On some occasions, also, the sunsets were of extraordinary beauty, when mingled with snow-capped peaks, were packed masses of clouds, having the most exquisite combinations of colour—blue, orange, gold, or purple—and producing an effect which, for beauty and grandeur, I have never seen equalled.

“ The inhabitants of the Reef are divided into 18 tribes, and, judging from what I saw of them, their

social village life, though primitive, is not unhappy. Pastoral pursuits and agriculture are their chief industries, while, living simply, close to nature, in the fresh air of their mountain homes, they have become a robust and hardy race. The Reefians are not nearly so dark as the inhabitants of the plains, many having fair hair and blue eyes ; the women, also, I remarked, do not practise the same seclusion as their sisters in other parts of Morocco, and many are extremely pretty. The men are invariably armed with long knives and firearms, a necessary precaution, for in the Reef it is a saying that every man's gun is the law. Only a few years ago, the chief weapons were the antiquated Moorish flint-lock, with which the peasantry generally throughout the empire are armed ; but lately American rifles have been introduced, and about four-fifths of the men I saw seemed to carry them. During a recent tribal dispute, a battle was fought by men, on each side armed only with the new weapons. Those who possessed nothing better than the old-fashioned guns, having carefully got out of the way of the line of fire, sat down, and looked on, saying their arms were no use against the inventions of the Christians.

“ Along the Reefian coast, at different places, are inlets, which, it is said, might easily be converted into excellent harbours. Smuggling feluccas ply their trade along the coast, discharging and taking in cargo at these points, and it is thus that rifles are brought into the country ; some also being smuggled in through the port of Tangier. There being no law recognised throughout the Reef, except the will of the tribal chiefs, and there being no courts of justice of any kind, their place is supplied by the observance of a species of vendetta, or blood-feud. Thus, should one man kill another, even by accident, some relation, usually the next-of-kin, is bound to murder the one who occasioned the death. But this man's relations are, in their turn, bound to exact vengeance, and so the feud is perpetuated for generations. Young children are taught, from the time they can speak, that it is their duty when they become men, to cause the death of some particular man who is named to them, possibly a near neighbour. As a consequence of this practice, murders are extremely common, and I am told on good authority, that more than 50 per cent. of the male population die by violent deaths.

“ I have reason to believe that rich mineral deposits exist in different parts of this district ; especially copper and iron. Coal is certainly to be found, for we passed one spot where seams of it were cropping out of the ground. The people had evidently been carrying away some of it for use, as large loose lumps were lying about.”

Such is the description given by the Shereefa of a hitherto unknown region. When the Moorish Empire may be brought under the influence of European civilisation, and free transit through the country becomes possible,

perhaps not the least attractive portion to the foreign tourist will be the hardly-known Switzerland of Morocco.

The great chain of the Atlas forms a mountain system, which for the grandeur and magnificence of its romantic scenery, is, perhaps, not to be surpassed by any in the African Continent. This range extends into the adjacent French possessions in Algeria, but in Morocco its length is about 300 miles, of which 30, stretching from the sources of the river known as the Oued Tissout, attain a general elevation of about 12,000 feet. On approaching this imposing mountain line the aspect is truly sublime, and one of which a mere description must fail to convey a true idea. At the time of early dawn in certain seasons, these lofty heights are embedded in masses of white mist, which, under the influence of the rising sun, dissolve with the appearance of a thin, gauzy veil, disclosing a magnificent panorama of mountains rising behind mountains, and producing a striking impression of the grand, unequalled majesty of nature. Towards the Atlantic on one side, and in the direction of Algeria on the other hand, a broad line of snow edges the mountain tops, glistening like silver in the sun-rays of early day; and at intervals loftier snow-clad peaks tower up, piercing the background of dark blue sky. Just below the region of snow, the mountain sides are intersected by broad valleys, bounded by wild craggy heights; but lower still, where vegetation commences, the slopes are furnished with forests, stretching, at places, into long expanses of park-like woodland of pine, oak, walnut, and larch trees, growing with wonderful luxuriance.

The view of the landscape, looking down 5,000 or 6,000 feet, is variegated and beautiful, for, watered by thousands of rivulets pouring from the base of the Atlas, there stretch away miles of fertile country, strewn with Berber hamlets, plantations, and fruit orchards, the deep green grass land and cultivated fields, diversified with gardens and groves of orange, lemon, palm, and myrtle, producing the most charming harmony, combination, and contrast of colouring as far as the horizon, and the *tout ensemble* presenting a landscape of the most enchanting beauty.

ISRAEL IN AFRICA.

The native Israelites of Morocco form a considerable portion of the population, numbering about 280,000 persons. They are divided into three separate classes — the

Spanish, the Moorish, and the Atlas Jews. Each arrived in Barbary at a different epoch; each speak a separate language; each inhabit a different portion of the empire; and each, living under totally distinct conditions, hold but little communication with the other two.

When, in the year 1492, Ferdinand and Isabella issued the edict of expulsion, by which the Hebrews were ordered to leave Spain within four months, it became with that ill-starred people a serious question in what part of the world they could take refuge. In Christian Europe their co-religionists were exposed to cruel persecution; and even where they were nominally tolerated, they were surrounded by restrictions and subject to special adverse laws, owing to which they were kept in a state of poverty and degradation. A considerable portion of the expelled Israelites decided on emigrating to Barbary, on account of its close proximity to their native land, and, perhaps, also owing to the fact that the Moors of Spain had, since the conquest of that country, treated the Hebrew population with a degree of justice and consideration, which was not afforded to the oppressed community by any Christian nation.

The result, however, by no means justified the anticipations formed, for the Moors on the African side of the straits, were a much fiercer and more barbarous race than those in Spain. The former country was also in a great measure inhabited by wild Mohammedan tribes, who, subject to no rule but that of their chiefs, were at the same time imbued with an intense sentiment of fanaticism against all who were not of their own creed; and it is recorded that as one shipload after another of the wretched emigrants disembarked on the shores of Barbary, the fugitives were subject to outrage of every description from the inhabitants. The edict by which the Jews were expelled from Spain, was accompanied by clauses, owing to which their wealth had been practically confiscated. Nevertheless, many of them had contrived to secrete some money and jewellery, of which these victims of Christian bigotry and Mohammedan fanaticism were ruthlessly plundered. Thus, homeless, friendless, and pillaged, they found themselves unwelcome guests in the inhospitable Moorish land; hated and despised by the natives, subject to laws which persecuted, instead of protected them, and exposed to daily insult and outrage from an ignorant and brutal population. Many died under their accumulated hardships, many were murdered by the hill tribes, others were sold

into slavery, and some, unable to face such conditions of existence in Morocco, retraced their steps to Spain, and accepted Christianity as the price of permission to reside in their native country. A remnant of the people, however, elected to remain in Morocco, where they settled, chiefly in the coast towns; and there their descendants have continued to exist to the present day. Those on the northern coast speak an antiquated dialect of Spanish, in use at the time of their expulsion, exercise a rigid observance of their religious rites, and for the most part, wear the ancient costume which in Spain and Barbary was formerly designed as a badge of degradation. The condition of this class of native Israelites has of late years become much improved; they are now protected by the fast growing influence of European opinion, and the commerce of the country is, in a great measure, in their hands. Being the chief money-lenders and bankers, their general prosperity is increasing, and many occupy the position of agents to French and English mercantile firms.

Their social position is now much better than it was some years ago, a fact, perhaps, mainly due to an educational movement which has now taken its rise among them, and which will, without doubt, eventually place them in a more advantageous position than they have ever occupied in the Barbary States.

The second division of native Israelites to which I made allusion, under the name of Moorish Jews, are the descendants of those who, after the Roman conquest of Palestine, on the general dispersion of their race, found their way to Mauritania, where they settled, forming small communities in the different cities. From the first, these immigrants appear to have been engaged in commercial pursuits; and during the Roman dominion were not subject to any special injustice; but on the Mohammedan conquest, which was completed in the early part of the eighth century, they found themselves under a yoke which, until lately, has been one of systematic persecution. Even at the present moment, the Jews of the interior are obliged to walk barefooted in the streets, are liable to mob outrage if they appear in any but the dress before alluded to, and are confined to a residence in a particular quarter of the town, composed of narrow, filthy lanes, called the Mellah, surrounded by walls, the gates of which are closed at night.

As may be supposed, education among this class of Jews is at a very low ebb. Their

language is the dialect of Arabic, spoken in Morocco, but there are schools attached to the synagogues, where the pupils are taught to read the sacred writings in Hebrew, and here their instruction may almost be said to end. Superstition, the invariable outcome of ignorance, has engendered among these Israelites a regard for a multitude of rites and observances, many of them meaningless and irksome, others demoralising, and replete with evil consequences; and customs prevail, not only not in accordance with the Judaism professed by the Israelites of Europe, but absolutely contrary to their ancient faith. As an instance of the above, I may mention that early marriages are sanctioned to an extent, which must, in more ways than one, be followed by objectionable results; for, strange as it may seem to the inhabitant of Europe, it is a fact that both partners are often boys and girls of about twelve years old. It is very common also to see little girls of the above ages the brides of men past middle life, and these child wives, often mothers at fourteen, are broken down faded women at twenty-five. I am happy to state, however, that the "Alliance Israelite" having been made acquainted with the degraded condition of the Moorish Jews, is now making efforts to give them the same educational advantages which the society has for some years past conferred on those of their own faith residing in the coast towns, and already a school on the European system has been established at Fez. The first step having been successful, it is in contemplation, should sufficient funds be forthcoming, to extend a good system of modern education to the different cities and towns throughout the empire. If this be done, the results accruing from long centuries of ignorance, superstition, tyranny, and isolation will be dissipated; knowledge and science will assert their sway; and the Israelites of Barbary will be enabled to play an important part in the future regeneration of their adopted country. Among other causes which have contributed to keep the Jews of Morocco a distinct people, may be mentioned the fact that they have always formed an *imperium in imperio*, the rabbis administering the laws which are binding on the Israelite community. In criminal cases, when both parties are Jews, the amount and nature of punishment to be inflicted is decided by the rabbis, the delinquent then being handed over to the Moorish authorities who carry out the sentence. Among the wild tribes of the Reef mountains, and the nomadic

tribes of the plains, may be found a number of Moorish Jews. Though living in a species of serfdom, all accounts support the opinion that they are perfectly contented, being well treated and protected from injury by their Mohammedan masters. It is a significant fact that it is only in a somewhat higher state of civilisation, when the Jew living in the cities becomes a usurer and a trader, that he incurs the hatred, and is subject to the persecution of the Muslim population.

The Atlas Jews form the third division of the native Israelites, and their legendary history is of a singular character. They say that at a very remote period of time, prior to the Babylonian captivity, some political convulsions which agitated the Jewish state, caused considerable numbers of the people to leave Judea in search of another home. They wandered along the southern shores of the Mediterranean until they arrived in the land now known as Morocco, where they appear to have been well received by the inhabitants—at that time a Berber race—who accorded them full religious freedom. As, however, Carthaginians, Romans, Vandals, and Arabs, in successive waves of conquest, appropriated the country, those of the Berber tribes who could not reconcile themselves to a foreign yoke were gradually driven back to the mountainous districts, and especially to the great chain of the Atlas. The early Jewish race shared their lot, and the descendants of the latter now live in a state of perfect freedom with the Berber mountaineers. The Atlas Jews speak the Berber dialect; are scattered among the hill clans; are allowed to bear arms; and are said to be a brave, independent race. They hold but little communication with the Jews of the plains, and the small amount of trade carried on from the mountains is in their hands. It is said that they possess only a portion of the Hebrew sacred writings, and that their religion is free from the degrading superstition of the Moorish Jews. Richardson, in his work on Morocco, quotes Procopius, the Byzantine historian, as stating that at the time he wrote—in the sixth century—there existed in a North African town, called Tigisis, a column, having the following singular inscription:—"We are those who fled from the Jewish robber, Joshua, the son of Nun."

Some consider this Tigisis to have been situated close to the site of the present Tangier, but the more general opinion is that it was a town in the district now known as

Algeria. The statement of Procopius is, to a certain extent, corroborated by a tradition of the Berbers, who assert that their ancestors formerly inhabited Canaan, but were driven forth by an irruption of a horde of Jews. Should it be a fact that the Berbers are the offspring of a former people inhabiting that country, it is not a little curious that the two races which contended so long ago for the land of milk and honey, should have ended their wanderings, and be now living in harmony together, in the lofty and secluded Atlas ranges of Morocco.

DISCUSSION.

MR. HENRY BLACKBURN said he had a certain familiarity with the subject of this paper; for instance, one of the views which had just been shown represented the room in which he had slept for many weeks. As long ago as 1856, he was a member of a small expedition that landed at Oran, in Algeria, one of the western ports bordering closely on the Reef district, of which a description by the Shereefa had just been read. They were adventurous young people, mostly artists, and having heard that this country was so difficult of access, they immediately started to visit it, but very soon had to turn back. In fact, never until now did he know so much about it; for it was still a *terra incognita*. They owed a great deal to Captain Rolleston, not only for his very interesting paper, but for the work he had been doing in exposing the terrible oppression and cruelty that went on in Morocco, and had been going on for a long time. He had written many papers about it, in newspapers and reviews, though he feared they had not attracted so much attention as they deserved. How did Captain Rolleston come to know so much about Morocco? In 1871, having been recalled from India, with his regiment, the 74th Highlanders, he made several trips across to Morocco; later on, he stayed there for some years, and occupied himself in trying to expose and suppress that terrible *protégé* system, which still existed to a great extent. The three men who had done most in this direction were the late Sir Kirby Green, Captain Rolleston, and Mr. Ion Perdicaris, an American gentleman who has lived for some years in Tangier. On one occasion he (Mr. Blackburn) was starting for America, and by accident met in the railway carriage this very gentleman who told him he was going to Washington, to the President, to expose the evils of this *protégé* system, which was being carried on in Tangier under the American flag. He accompanied him to the White House, and had the satisfaction of seeing a decree signed, removing the man who was lending his countenance to this system, and appointing some one else in his place. At the same gentleman's house, only a few years ago,

he met the lady who married the Shereef of Wazan, who, he believed, was the daughter of the Governor of Pentonville Prison. She went out to Tangier as companion in this family, and while staying there the Shereef saw her, admired her very much, and finally married her. At one dinner party the Shereef kept them waiting a long time, having been out boar hunting, and when he came did not present a very dignified appearance—he was a little man, and had rather a shabby appearance. The Shereefa knew a great deal about the country, and was evidently clever at description; and he hoped by and bye she would be induced to communicate further information about it. In conclusion, Mr. Blackburn asked Captain Rolleston to give the proportions of the different races in Tangier at present. He believed, out of 12,000 or 15,000, about 8,000 were Spaniards. The language and coinage were Spanish, and, practically, it was a Spanish place. This was a matter of importance, when one remembered that some joint protectorate would probably have to be established there.

Dr. OSWALD asked if the Shereefa were still alive? He would also ask Captain Rolleston if it had ever occurred to him, during his stay in Morocco, that some of these so-called Jews were not Jews, but Phœnicians or Carthaginians? They knew that Spain was full of Carthaginians, and, as far as he knew, there was no record of any large immigration of Jews into Spain.

Captain ROLLESTON said the Shereef of Wazan was dead, but his widow still lived in Tangier. He thought the Jews of Morocco were a pure race, and not Carthaginians. There was good evidence that a great many Jews were forcibly converted to Christianity, and possibly some might have been converted to Paganism, but there was no evidence of any large bodies of people being converted to Judaism, though individuals might be. Their religion, therefore, must be considered conclusive as to their origin.

The CHAIRMAN said the paper had been a very interesting one. Morocco was probably, notwithstanding its being so near to one of the British possessions, the least known part of northern Africa. Since Algiers had become French—and even Tunis had begun to develop under French influence—and Egypt had come under English occupation, those parts were well known to Englishmen, to many from personal knowledge, and to almost every one at second-hand; but Morocco was still comparatively unknown—very few having visited it. Yet it was obviously a country which, from its position, was of great importance to both the political and commercial interests of this country, and any information about it was therefore of great value. He imagined that it was still in a very primitive condition; far more so than most other Mohammedan countries. A curious point had been raised as

to the race-origin of the Jews; and he presumed that, as Captain Rolleston had said, the Jewish religion was tolerably clear proof of their descent. He was curious to know whether the other race mentioned, who spoke of having been expelled from their own country by “the Jewish robber,” Joshua, were presumably of Phœnician origin. He imagined the Syrians were much the same race as the Canaanites, and a Phœnician colony would be of close kindred to the inhabitants of Palestine before the Jewish conquest; but he did not know how far that connection could be pressed. He presumed they would be of entirely different race from the Jews. He concluded by proposing a vote of thanks to Captain Rolleston, which was carried unanimously.

Captain ROLLESTON, in reply, said the records of the Berber races were very scanty. Very possibly the races of Canaan had a Phœnician origin, but if so, they were expelled by the Jews. There was nothing to go upon but the Berber legends, and all they said was that they formerly lived in a land called Canaan, and some Jews came there and expelled them. As to their own history, prior to their going there, they knew absolutely nothing.

EIGHTH ORDINARY MEETING.

Wednesday, January 24, 1894; Sir JOHN B. MONCKTON, F.S.A., Master of the Worshipful Company of Coach Makers and Coach Harness Makers, in the chair.

The following candidates were proposed for election as members of the Society:—

Bennion, J. A., County-offices, Preston, Lancashire.
Clémence, Auguste, 34, Ely-place, E.C.
Fisher, S. Melton, Arts Club, Hanover-square, W.
Gritton, Joseph, 97, Highbury-quadrant, N.
North, John William, A.R.A., Beggearnhuish-house, Washford, Taunton.
Sanders, Henry F. C., The Camp, St. Alban's.

The following candidates were balloted for and duly elected members of the Society:—

Baker, Albert Pomeroy, 57, Deansgate, Manchester.
Brigg, Thomas H., Farfield-house, Buttershaw, near Bradford, Yorks.
Mitchell, Charles A., 16, Titchfield terrace, Regent's-park, N.W.
Picard, Hugh Fitzalis Kirkpatrick, 59, Abbey-road, St. John's-wood, N.W.
Thrupp, George Herbert, 425, Oxford-street, W.
Vincent, T. J., Victoria-embankment (next Temple Station), W.C.

The paper read was—

AMERICAN CARRIAGES.

BY GEORGE HERBERT THRUPP.

For some years I have been acquainted with American carriages which have been imported to England, and the study of which aroused a lively curiosity in my mind to see more of them. They are beginning to be known all over Great Britain, especially those of the lightest order. In 1892, 250 came from the States, and 47 from Canada; most of the latter were probably sleighs. Before my visit to America the only collection of American carriages of the heavier and more expensive class I had seen were those exhibited by Messrs. Brewster and Co., and of Messrs. Healey, of New York, at the Paris Exhibition of 1878. Although very young, and, consequently, inexperienced at that time in the art of coach-making, I was more impressed with their beauty of outline and finish than with anything else exhibited, and that is saying a good deal, considering the high quality of the French carriages then shown, which pleased my English taste in every way for light appearance and good finish. This is not now the case as regards the former point; French carriages, whilst still maintaining their excellence in finish are being made too solid, and heavy looking to please the taste of the British and Colonial carriage buyers. The opportunity afforded me by the Society of Arts and the Institute of British Carriage Makers to represent them as the Carriage Judge at the World's Fair was an honour of which I was glad to avail myself.

When I arrived in the States, I was at once impressed with the importance of the carriage-building industry; blocks of buildings of great magnitude I found devoted to the purposes of carriage manufacturing, situated in the most important thoroughfares of the great cities. In New York are the firms of Messrs. Brewster and Co., Messrs. J. B. Brewster, Messrs. Healy and Co., all ranking as first-class builders; Messrs. Flandrau, Messrs. Curley and Co., and many other important houses. Messrs. Kimball and Co., Messrs. Studebaker, and Messrs. Stone in Chicago; Messrs. James Cunningham and Son in Rochester. The city of Cincinnati is a large centre of the carriage industry. In 1892 they produced 125,000 carriages. Amesbury, in Massachusetts, contains also many carriage works. Boston, Philadelphia, &c., are all well represented.

In 1790, there were twenty carriage-makers in America, and in 1894 they may be reckoned by thousands, employing hundreds of thou-

sands of workmen, and with millions of money invested in this vast industry.

I was pleased to see the high social position coach-making holds in relation to other crafts; it certainly stands far better than in Great Britain. This is due partly to the democratic tendency of the American nation, and also to the way luxuries have been created, as wealth has been amassed and new cities become great, the carriage-maker extending his business as his fellow-citizens became successful in their different callings. The tone of American society is decidedly luxurious, and everybody who can afford it keeps his carriage for business or pleasure purposes. From climatic reasons, in a certain measure, both American men and women prefer driving to walking, and in a very large portion of the States a carriage of some kind is indispensable. It must be remembered that the first development of the Western States was by means of waggons, which were made by the coach-maker. The first railway carriages made in America were built on the model of the old-fashioned coach with leather tops, but supported on iron wheels to run on the new railroads. A few of those still existing were exhibited at the World's Fair.

There are two classes of carriage made in America, one class comprises what is termed "Fine Carriages," such as landaus, broughams, victorias, coaches, drags, &c. The other class, comprising the lighter kind of vehicles, such as buggies, buckboards, surreys, spiders, sulkies, &c., which are usually driven by the owner, and are more suitable to those parts of the country where the roads are very bad, and unsuitable for the heavier class of fine carriages.

I do not think the British public always know what a carriage really is. Some people imagine a carriage is made like a kitchen table, but painted and trimmed elaborately, yielding an enormous profit to the maker of, say, 100 per cent. If it shows signs of wear after a fair amount of use it is called bad, because it does not wear in the same way as a wardrobe or a sideboard. Other people think that to make a carriage by machinery you have only to put into one end of the machine so much iron, wood, paint, varnish, leather, and cloth, and by turning a handle and passing the ingredients through different moulds the carriage will come out complete at the other end of the shape and colour desired. Carriage-making is not done in this way. A carriage is an elaborate machine, which may rank with a

steam-engine, yacht, &c., if the necessary education is considered which qualifies a genuine coachbuilder. If it is treated with care, properly maintained, and looked after by a man with a head on his shoulders, it will last for many years, and give satisfaction to all concerned in its production and use; but if it is treated as a garden roller or a wheelbarrow, by clumsy and ignorant people, it will very quickly get out of order, and require repair at considerable cost.

America has a great advantage over Europe in carriage-making from its great natural resources; and more than that, it has the advantage of the brains of every nationality in Europe. In the workshop, side by side, are found French and Swedish smiths, Irish painters, German trimmers, Italian carvers, and English and American body and carriage-makers. Such a cosmopolitan union of workers would not be tolerated by our English trades' unions. The wages paid are very high, ranking more than double in comparison to those paid in England and France, and more than treble to those paid in Belgium, Austria, and Italy. Unskilled labour is paid in New York, to porters, washers, &c., about 8s. to 9s. a day; skilled labour receives from 14s. to 20s. a day. I was informed by some employers that there is no trade in America where there is less friction between the employer and the *employé* than the carriage business, nor where the skilled mechanic receives better wages or is better contented with his lot. The Carriage Builders' National Association is a very important body, and whilst only founded 21 years ago, it now numbers some thousands of members. It has founded technical schools for teaching the mysteries of the craft, and has done a great deal of useful work towards improving roads and classifying freights on land and water.

The employers, and the various members of their respective staffs, struck me as being men of bright intellect, good education, and possessing great energy and enterprise. They are principally men who have studied their craft all their lives, carrying on their business in their own names, which is very different to the rule in London, where many businesses are conducted by men who have found other professions and trades to be unprofitable, and try coach-making as a last resource, experimenting on the credulity and long-suffering of that portion of the British public which is gulled by plausible advertisements, and other forms of illegitimate trading.

It is simply wonderful to hear of the way in which some businesses in America have risen from nothing in a few years. That of Messrs. Studebaker Bros. was started as a small wheelwrights, at South Bend, Indiana, in 1852, with a capital of 68 dollars—*i.e.*, £14. In 1893, they employed 1,860 men; their works occupy 95 acres, and their output is the largest in the world. At South Bend alone, they make 50,000 waggons annually. They have branch houses at New York, San Francisco, Kansas City, Salt Lake City, Portland, and St. Joseph.

In Chicago they employ nearly 200 men, in a huge building with eight floors, for the manufacture of Fine Carriages. The hours of work are ten, exclusive of meals. The smithy, with 16 forges, is on the eighth floor; they have every improvement in modern machinery, and keep a luxuriously fitted elevator hard at work for the use of their patrons.

Messrs. Kimball and Co. have built up a splendid business at Chicago, and carry it on in a princely block in Michigan-avenue. They employ over 200 men, and their annual turnover is not far short of £150,000 a year. Their business was founded by the late Mr. Kimball some eighteen years ago, and their carriages take a lot of beating. The present head of the firm, Mr. C. F. Kimball, had the advantage of being trained for the bar, after a University education at Harvard, and is the popular president of the Carriage Association. Though still young, he has travelled all over Europe, and is the highly valued friend of many European coachmakers.

Messrs. Brewster and Co., of New York, do the largest trade in Fine Carriages, and their turnover approaches £250,000 a year; they employ 500 to 600 men. Their smithy contains 44 fires, and they make everything used in the construction of carriages except the axles. Their works are situated in Broadway, and cover a large extent of ground. The carriages are made on beautiful lines, showing admirable originality and artistic taste of the highest order.

Messrs. Healy and Co. are also in the Broadway, and vie with Messrs. Brewster in turning out beautiful work. They have just built new works, which are the most admirably planned to meet trade requirements that I have ever seen. Mr. Healy, the principal, has been termed the "aristocrat" of the trade; he has lived a great deal in Europe, and is a great artist. Carriage-making is his particular hobby, and he quite holds his own with any of his rivals in the States.

There are plenty of other enormous concerns, which I had not the time to visit.

As regards the style shown in fine carriages, it is, at present, quite different in most respects to that in fashion in this country, especially in landaus, broughams, and victorias. Some twelve years ago, the French Exhibition of 1878 appears to have set the fashion, judging by the old carriages one sees about, which were light-looking, compact, and somewhat small. Now, the Americans have struck out almost a new line of their own. Their landaus are certainly modified copies of old patterns made in Europe 40 or 50 years ago, the outlines and general appearance being very heavy, even clumsy, to the English eye. Their embellishments are also heavy in character, consisting of elaborately carved work highly ornate, with heavy lamps and metal work, few having the automatic opening head so popular here. The iron work, although well forged, is very substantial. The broughams are more original in design, and the outlines of some of them were quite unique—the windows very small, the bodies very deep, the doors often hinged on the front pillars, the dashers curved, and many mouldings on the body, often carved, and of serpentine form. They possess many of the points which distinguished the broughams of 40 years ago. In a few instances, even opera boards—to protect the back panel from injury—and sword cases have been revived. The victorias are all called cabriolets in the States, if they have a wooden boot or driving box, and are quite original in design. Those made by firms like Brewster and Healy are not inelegant when one gets accustomed to them; but when exaggerated with deep sides and double-panelled quarters of a high character they look absurd, as they almost conceal the occupants from view, and necessitate a pair of large horses to look at all correct. The third, or occasional seat, is concealed in the top of the boot, under the coachman's seat, and works on a pivot; an ornamental leather flap, with a watch-case in the centre, conceals the rugs when not used.

What they term a victoria proper is a similar carriage, with an iron or skeleton driving seat, and a large leather dasher, but this is now out of fashion, and the cabriolet has taken its place.

The double-seated broughams are made with rounded fronts and three glasses, and are called extension-top broughams, as distinguished from the coupé or single brougham. In England this shape is not now made, for the

square-fronted brougham is the only shape asked for. The points of the single broughams apply to these extension-top broughams, and none that I saw would look well with one horse. There is another kind of brougham which is called a "Rockaway," which is hung higher than an ordinary brougham, and has a low coachman's seat, which is covered by the roof being extended over it; it has windows in the sides and back, and many are made to be used in hot weather with the sides open, the roof being a fixture to protect the occupants from the sun. The "Rockaway" is an admirable carriage for use in a tropical climate, but would be too draughty, and the driving-seat too peculiar, to please the English public or coachmen.

The drags are principally copies from English or French four-in-hand coaches. Some of our old-fashioned mail coaches have been reproduced very cleverly, and with the addition of original and artistic fittings, which are not put in England; the Americans I suppose do not grudge paying extra money for the extra value given them in these respects. Old-fashioned colours have also been revived, which give a pleasing effect to the appearance of the carriages. In general construction there is little deviation from the orthodox shapes in vogue in Europe; this also applies to mail phaetons and tandem carts, and some of the heavier spider phaetons. The older designs of 25 years ago, of a substantial and solid character, are preferred to the skeleton grimcrack things turned out by cheap country firms for London carriage companies at the present time. Some of the former exhibited at the World's Fair seemed to be old friends come over from Hyde-park, and refurbished and decorated by the artistic hand of the American.

Their brakes, or *chars-a-banc*, were particularly smart; most of them had deep boots, to carry hampers, and rows of from three to five seats. The Venetian shutters were let into the sides, to detract from the heavy appearance, and with yellow or red wheels, and pigskin or drab cloth cushions, the effect was very pleasing. Brakes, both to the back and the front wheels, drag shoes, well-fitted luncheon baskets, lamps, and horns were not wanting to make them look complete. The idea of their design was decidedly European, and showed little originality. The linings in all these carriages were beautifully made, light, cheerful colours being preferred, such as drab, grey, ruby, &c. Some new shades were introduced, in admirable harmony, satin, silk,

and cloth being more used than morocco leather. The "picking out" of the wheels, where the body colour was dark, showed little novelty. Mr. Kimball's rainbow picking out was quite new to me, and very effective.

We will now take the light carriages. The piano-box buggy is still very much used in the States, and is the lightest thing made. The weight is its *raison d'être*, as there are many parts where an ordinary carriage could not be used at all. The four wheels are high, of second growth hickory, which is of the nut tribe, and of rock elm; the former possesses very elastic properties. The body is extremely light, and is usually supported on two single-plate cross-springs attached to two side-bars. The draft is from the axle; by means of the shafts, which are framed together, it cannot be turned in less than its own length; it is very closely coupled together, the top or head is very light, and can be used with the sides and back open or covered, to suit the weather. Many are made for one person only, and none for more than two. The weight ranges from 100 to 350 lbs., and the cost is as low as £10 and as high as £90, according to the quality, and they wear from 12 months to 12 years, and even longer. A £10 buggy would not be worth repairing, and is a very poor thing when put into use. A horse can draw one of these buggies a mile in two minutes and a-half; everybody who keeps a carriage at all has one of these in his stables. The trap, or four-wheeled dog-cart, is likely to drive them out of fashion as the roads improve.

There is a very great variety of this kind of carriage made in America, and they appear to be becoming fashionable; the weight is much the same as those made in England, only the gear, or underworks, and wheels are somewhat lighter than is general with us. It is customary to make half of the front seat to hinge and lift up, to enable ladies to pass from the front to the back without climbing in behind or over the wheels. Some are made with the side to jump forward, by several ingenious plans, so that one may enter between the wheels. I am sure that this arrangement will not last long, as, when the mechanism gets out of order, as it must necessarily do, a rattling will be created, and annoy the occupants. The colouring is generally red or yellow for the wheels, and dark-coloured bodies, picked out to match. Dust coloured or drab cushions are most popular, considering the thick dust which lays in the roads. None of this class have tops, and thus resemble those made in Europe.

A great deal of originality in design is displayed, and some of the traps are very stylish and smart.

The "Surrey" is a very popular vehicle, and would suit the English public, if only they are willing to pay the price. It is really what we call a Siamese phaeton, with a fixed canopy top, or an extension top, which means a double hood to the back seat, half of which can be fixed on to the front seat at pleasure. The sides of the top are opened or covered, according to the weather; there are no doors. The prices range from £60 to £130, according to the quality. It seats four people, including the driver, and is light and compact. It is used both as a public and private conveyance, and made either with the front wheel to turn under the body—to turn easily in a narrow road—or else on the American plan, with a light perch and the front wheel high, to make it run more lightly.

A little phaeton with a top to seat two inside is also much used, and is, of course, much cheaper; the cab-body is the favourite shape for this. Runabouts and buckboards are shapely little bodies on four wheels, without tops, to seat one or two people.

The sulky is most popular for racing purposes, and is used on special trotting tracks. This form of amusement of driving in competition is a very favourite one with Americans, as of course you know. Sulkies are practically skeleton carriages with two shafts, a sort of bicycle seat of the most uncomfortable kind, and two high wheels of hickory wood, or two low wheels with pneumatic tyres, and an axle-tree with ball bearings, as is used for bicycles—these latter are considered to be the very best for swift racing on the tracks, and have scored shorter records than the high hickory wheels and common axle. The driver sits at the back of the horse's tail, with his legs along the shafts hugging the horse's sides. I cannot see where the pleasure of driving comes in in this uncomfortable position.

I will say nothing about the American wheelbarrow, as some of you present may have already heard me expatiate on this vehicle when I was judging carriages at the World's Fair; it is similar to the European wheelbarrow.

The public conveyances that I saw were of a very superior order, and seemed to be usually the cast-off carriages of private people; there were a few hansom cabs of English make in New York and Montreal. I do not think the Americans care about using two-

wheelers, as they do not afford security to those inside should the horse fall, which is a great point in favour of a four-wheeler. The prices charged for hiring public conveyances are so high that one would not think of using them unless one was obliged; 10s. or 12s. an hour for a one-horse conveyance in New York and Chicago is considered moderate. In other places they are much cheaper, especially light phaetons like the surrey, which one can hire from 4s. to 6s. an hour. Trams are used generally in large cities, and the elevated railways in New York and Chicago carry one for any distance for 2½d. Omnibuses are rarely seen, and, judging by the style of the few I did see, they are old-fashioned and out of date. The hotel omnibuses are fairly smart and comfortable. The Americans will not stand such awful traps as the London four-wheeler, the existence of which is a mystery in these days of luxury and civilisation. No doubt, if people would only pay a higher tariff for the hire of four-wheel cabs, a better form of vehicle would take its place.

The materials used in carriage-making are principally made in the States. Some English cloth, from the neighbourhood of Stroud, is used by the best makers; and the business might be largely increased by the English cloth manufacturer, were he to push his goods with the American carriage-maker. France sends axles, lamps, and metal ware to a few makers, but in no large degree.

The Americans are famed for their wheel making, and keep enormous quantities of the best timber stored for this purpose. Second growth hickory is the favourite timber used. When a forest has been burnt or cut down, the hickory tree grows up in a vigorous form, and the toughness and elasticity which it possesses renders it, when properly seasoned, most suitable for the manufacture of the American wheel, and it suits that climate far better, from my experience, than the damp English climate. The Warner wheel, with its iron hub, whilst giving a light appearance, seems much more used in England than in America, where I hardly saw it at all. The principal of fitting wooden spokes into an iron hub is questionable, and when the spokes become loose, the rattling is unbearable.

Steel tyres are universally used in preference to iron, and rubber tyres from England—from the Noiseless Rubber Tyre Company—are becoming very popular. Steel is very little used in the gear or under works except in some

of the racing buggies. There is an ignorant theory existing among some people that, by the use of steel, a great deal of weight may be saved in a carriage; if anybody was to weigh the steel parts in one balance against the iron in the other, the difference would be found to be infinitesimal, and, if used in the carriage, the manufacturer would have far more confidence in the strength of the forged iron than in the steel, which often develops flaws which cannot possibly be detected until too late.

I heard of steel edge plates being used by a good maker in the States—plates which support the frame work of the body—and then broke in several instances, doing injury to the carriage and to the reputation of its maker.

I was very much struck with the absence of shabby carriages about the streets; the American is very proud of his surroundings, as he is so often the founder of his own fortune, and he does not leave off in his luxuries when it comes to the carriage. From what I can judge, he seems to offer every inducement to the carriage-maker to produce something as perfect as possible, in order to emulate his neighbours, making price a secondary consideration.

This demand for a superior carriage is a great incentive to the carriage trade, with the result that the craft is developing and becoming a greater art than in our own country. Designers of the greatest ability are sent to Europe every year to pick up new ideas and originate fresh designs to satisfy the requirements of their countrymen. In Great Britain the case is reversed; nine people out of ten hunt round London in search of a cheap, second-hand carriage which, if only made flimsy enough without regard to the true principles of carriage-making, and if only cheap enough to suit their so-called economy, is purchased, to the prejudice of a genuine and superior article, and becomes a perpetual source of annoyance to the owner. The first thing required in an English carriage is that it shall be cheap. Beauty of design, soundness of construction, and superiority of materials, are being made secondary considerations in consequence; but for a good vehicle, a fair margin of profit is necessary, and, therefore, a reasonable price.

The prices in America for fine carriages are more than double those charged by the leading English and French makers. Their profits, so I understand, range from 40 to 60 per cent. *gross*, which is not too much, considering the enormous outlay required, the limited demand,

high rent, rates and taxes necessary for the large buildings, the personal attention and knowledge necessary, and the fact that the public are able to buy direct from the manufacturer without the intervention of a middleman. The prices of the light class of carriages are very elastic, and very small profits are made by some of the wholesale makers of buggies. Taking it generally, I should say that the carriage trade in America is in a far healthier condition than in Europe. The profits in our own country are very small in these days of over-competition and over-production, and whilst some old-established houses have been closed altogether for lack of orders, other large concerns show a loss on their annual balance-sheets, and others, again, make a nett profit of from 3 to 10 per cent. This cannot be considered a satisfactory state of things.

As a market for English carriages the States are practically closed, on account of the McKinlay tariff, which levies a uniform rate of 45 per cent., which the Americans do not care to pay, in addition to the expenses for packing, freight, &c. Were the duty reduced to half that, or even less, no doubt a great many English carriages would cross the Atlantic, and an impetus would be given to our home industry. Canada levies the same duty with the same result. It is to be hoped that some form of Imperial Federation may be arrived at ere long, so that our Colonies may encourage the trades of Great Britain with no prohibitive tariffs, which at present keep our export trade in a state of stagnation.

I have not said much about sleighs, because I was in the States in the summer months, and saw none in use. Brewster and Co. had a lovely specimen in the Exhibition, for which they asked £500. It was too fine a bit of work for use, and was more suitable for an ornament in a palace or museum. Messrs. Kimball exhibited a very smart little sleigh, which seemed to be well adapted to the requirements of Chicago. At Montreal, I went to Mons. Ledoux' carriage factory, and found him engaged, with some 80 French-speaking workmen, in making every kind of sleigh, this being his principal business. He was making one for the Duke and Duchess of York, to be a wedding present from the ladies of Canada, which promised to be very elegant. As sleighs are used at Montreal half the year, Mons. Ledoux makes victorias, broughams, and surreys entirely suspended on runners, which was a sight I had never seen before,

Harness is imported very much from Great Britain, as also saddlery and whips, &c., and they are very much liked. The American harness did not seem to me to be so good as a rule as English; it is very plain looking, and that used for trotters is very light, with breast collars. The whips are often made with a straight thong of whalebone in preference to those with a curved thong. Some of the coach-makers have large harness departments, in which they do a considerable business and sell every kind of stable requisite, and even make liveries to order. Harness-making has always been conducted with coach-making in England by some firms, but this department is being crushed out by co-operative stores, which generally supply an inferior article.

The Americans are fortunate in being protected from foreign competition by a 45 per cent. duty, and are careful in providing that if any carriage is imported it shall be accompanied by a certificate of origin, which has to be purchased by the importing manufacturer from the Consular office, in the place where the carriage is made. This is unfortunately not the case in England, where inferior foreign carriages are imported without duty or without a mark of origin, and then sold to the British public under false pretences by unscrupulous dealers to the prejudice of the British manufacturer and workman. If this is called free trade it certainly is not fair trade, and gives direct encouragement to dishonesty.

There are very good trade journals published. The best known is the *Hub*, and is a very complete work, appearing every month, and giving the best news and information about the trade in the States and elsewhere. A rival paper, called the *Carriage Monthly*, is a very bright and smart publication, and gave beautiful and complete illustrations of the World's Fair whilst it lasted. We have nothing to come up to these papers at home. This is of course partly due to the limited number of people engaged in the trade in these islands; but if our journals were made more interesting, they would command a greater circulation than they do now.

The nomenclature in the trade is very different in many terms to that with which we are cognisant at home. The wheel-plate is there called the fifth wheel; the underworks, the gear; the perch-bolt, the king-bolt; the stock, the hub; a round victoria, a cabriolet; a waterproof apron, a storm-rug, &c.

I ought to notice the wonderful hearses that

were exhibited at Chicago. Some of them were very costly, and showed very elaborate work; most of the carving was in very good taste, and must have taken a great deal of time to execute. A child's hearse was finished entirely in white. The prices of them varied from £200 to £600. The makers informed me that gorgeous funerals were the correct thing in the States, and handsome hearses or funeral cars were considered a *sine quâ non* to make them complete. No doubt this sentiment comes from the people of foreign origin, as in European countries, where the Roman Catholic religion predominates, gorgeous hearses are invariably used, a great deal of taste and real art being displayed in this class of vehicle.

In Great Britain old coaches and heavy landaus are dismantled, and converted in the cheapest possible manner into funeral cars, which are considered good enough to convey our dead friends to their last resting-place. Artistic funeral cars would not be purchased by English undertakers on account of their expense.

One vexed question in our country is that of weight, where the public demand excessive lightness in all vehicles, whether it is practical or not; in America, the tendency on the part of the public is to buy substantial, solid, and somewhat heavy-looking carriages, coming under the head of "Fine Carriages." Those now made are much heavier than those of 12 or 15 years ago. This is the result of practical experience on the part of both the makers and users, who find that if they are properly balanced on their gear and wheels, and made of proportionate strength, to suit their size and requirements, it is necessary to make the weight proportionate, so that they may be durable and comfortable to ride in; and this result it is impossible to attain, if undue lightness is insisted upon by the purchaser.

England is the only country where broughams and landaus are made too light to be permanently satisfactory; for, as they are closed carriages, their framework must necessarily be solid enough to allow the doors to open and shut without sticking, which often happens in very light carriages, and the wheels and gear must be strong enough to carry them. It is very easy indeed to make them light and attractive to the eye; but, to make them serve the purpose for which they are intended, is not feasible, unless they are made strong; hence, all first-rate coachmakers, both in America and

Europe, decline to make carriages which they know to be unsound in construction from beginning to end. In England they too often have to put up with a smaller business than they might otherwise have, in consequence of their desire to maintain their reputation for first-rate work. Lightness can be obtained far more easily in open carriages which have no doors or heavy tops and roofs, and this is a point usually studied in their construction all over the world; but as they are machines which are expected to bear hard usage and great exposure to the elements, the lighter they are constructed the more readily will they require repairing, and the sooner they will wear out.

Rubber tyres are a great preventive of decay in a carriage, as they protect a vehicle from the jar set up by the movement of the carriage along the roads, which is the real destroyer of its mechanical parts.

Before closing this paper, you may be interested to hear that the American roads are very bad, full of holes, ruts, and obstructions. Although the Americans are a wonderfully progressive people, they have not given this very important matter the attention it deserves, especially in the large cities, where the condition of the roads is often disgraceful and even barbarous in comparison with the magnificent buildings erected along their sides. A great deal of blame is ascribed to the municipal bodies, which consist largely of gentlemen of Irish extraction, and whose disposal of the rates is not considered as satisfactory as might be desired. Whether this may be a libel on these bodies or not, no doubt before many years have past a great reform will be effected. The system of level crossings over the railroads without gates or bridges at present exposes the life of the American carriage user to daily peril. In Chicago one is especially struck by the fact that all the great railway systems running from the south to the north of the city, cross the streets which run across them from the east to the west, and this occasions the loss of many lives during each year at these crossings, amounting to many hundreds. Michigan-avenue, one of the longest, broadest, and finest thoroughfares I have ever seen, is made dangerous by the cable-cars which run across it in a continual procession at a great speed and in both directions. We should not tolerate such an anomaly in this country.

I will now close this paper with my best thanks for your kind attention.

DISCUSSION.

Mr. G. N. HOOPER said he could confirm nearly all that Mr. Thrupp had said, having himself visited America some few years ago, and he would emphasise some of the points which had been made. The carriages might be divided into two classes—fine carriages, and trotting carriages. They varied not only in construction, but in workmanship and design, so that those who made the first-class seldom had anything to do with the second. The fine carriages were very expensive, while the light ones were extremely cheap. He had even heard of three being bought for £20. The reason for that was this: the country was of enormous extent; the roads hardly deserved the name; and yet a large number of people, with only small incomes, having long distances to travel, were obliged to have a vehicle of some kind or other, and it was probably better to buy three for £20, than to give the same amount for one, which it would be difficult to get repaired when it required it. The finest carriages were made of the very choicest materials, the wealthy classes insisting on having the very best of everything, which was a great encouragement to the makers, both employers and workmen. Of course, some of the trotting carriages were also very excellent, and would last a long time. He was convinced that it was wise economy to have carriages which were exposed to all kind of accidents made as good as possible. In America it was the rule to drive on the right-hand side, but he thought the English rule was preferable, looked better, and was safer. A valuable carriage ought to have the best care taken of it; with incompetent driving and careless use it was an expensive toy, and wore out rapidly, but well looked after it would last many years. The high finish, which was a feature of American carriages, was due in great measure to the education and intelligence of the workmen, which applied also to foremen and managers. Under the old system, when many of the men could not read or write, there were all sorts of prejudices against any improvement; but an educated man, who understood the reason of his work, and the directions given to him, took more pride in turning it out as perfect as possible. Mr. Thrupp spoke of the great convenience of the elevated railway in New York, on which you could go anywhere for 2½d. This was quite true; but he thought it must be a great nuisance to those who occupied houses along the line to have the travellers looking in at their windows. It was much better travelling on the railway than over the rough pavements, which were in such bad order that it was no wonder that cabs and omnibuses were not much used. The question of using mild steel instead of iron had exercised coachmakers for many years, and his experience was that, for the under part of carriages, the constant vibration had a tendency to produce crystallisation, and then it was liable to break; but for the bodies, where it was used in large masses, it had proved very successful. As to the profits

made in the carriage trade in America, he was told that those businesses which had been converted into limited liability companies had had diminishing dividends, which had come to nothing during the past year, so that it seemed as if the industry required an amount of care and watchfulness which could be ensured better by individuals than by companies. The Merchandise Marks' Act had done a good deal to put trade on a honest, straightforward basis, but carriages could be brought into this country without any mark of their origin, and it was easy to stamp them with English marks and pass them off as English. If such were the state of the law, the sooner it was altered the better.

Mr. JOHN PHILIPSON, jun., said he had visited the Chicago Exhibition, and was much interested in what he saw there. The buggies and light carriages could be hardly called works of art, though they were very useful in their way. Of broughams, landaus, and victorias, there were some very fine specimens, but it appeared to him that in many cases the outlines had been exaggerated so as to spoil their beauty. It was very satisfactory to hear that the American makers obtained such good prices, and he only wished they could educate the English public up to the same point. The driving of American coachmen was certainly open to improvement. As far as he remembered, most of them held a rein in each hand, and the whip was held in the right hand with the rein, or in the teeth. He had expected to hear something said of the aluminium carriage exhibited by Messrs. Studebaker, especially as aluminium was now occupying so much attention, and he should like to know if it was a success. The Ferris wheel also was a thing which attracted a great deal of attention, and he expected to hear some reference to it in the paper.

Mr. GEORGE A. THRUPP said the first thing which struck him in this paper was that the coachmakers of the United States had been endeavouring to do that which was certainly for the good of the industry, viz., to make everything as good as possible. His acquaintance with American carriages was confined to those which had been brought over to Europe, of which he had seen a good many, and he had been struck with the way in which skill and good material had been brought together. He remembered, in the Paris Exhibition of 1878, examining the exhibit of Messrs. Brewster, of New York, and was surprised to see how they had improved upon the French designs, which they had evidently taken as their models; where anything could be made lighter it was done, and in locks, hinges, and rebates, where one part of the wood folded over the other, and was continually jarring the moulding against it, there was a better finish than he had seen even in the best English work. He was not surprised, therefore, to find that they got good prices; it was, in fact, a better price for a better article. He believed coach-makers

had always endeavoured to produce as good an article as they could, because a carriage was not like a piece of furniture which could be placed on one side and left at rest. It was perpetually in motion, and subject to vibration, and therefore greater skill was required in the manufacture. The immense number of light carriages in use was no doubt owing to the distances of the towns and villages, so that every one who lived in the country had to keep a vehicle of some kind. Not having visited America, he could not speak of the roads from personal knowledge; but he had heard that in most of the towns they were abominable, and that in the country they were mere tracks, and of course that would account for some of the characteristics of the vehicles which had been used, some of them being heavy almost to clumsiness. Those he saw in Paris were as light as any of ours, and much the same in shape. The light vehicles brought over here had not obtained much favour, but he had seen one or two very wonderful country broughams, as he should call them, from New York, which seemed very promising, though so different in shape from the English that he should not wonder at their not immediately finding favour. They were roomy and exceedingly light. One lesson to be learned was that artistic display was thought more of than in England, the carving being more elaborate, and, as he gathered, the painting sometimes rather extraordinary. Formerly their painting was rather plain, as it was now in France and England. He could only suppose that the change of fashion arose from the number of foreign workmen employed, many of whom had a more cultivated taste than Englishmen.

Mr. COWARD said what American carriages he had seen were of a high order, both as regards artistic merit and good workmanship; though in many cases the lines were distorted and not in good taste. The light carriages also must be made on sound mechanical principles or they could not work so well as they did. He did not approve of mild steel for carriage building in place of iron, which contained no carbon; the presence of this element prevented good welding, as was evidenced by cast-iron, which contained a great deal and could not be welded at all, and cast-steel could not be welded properly. With good iron, two pieces could be so intimately joined that it would be difficult to detect the weld, and it would be stronger than anywhere else. This was the result of his 48 years experience in a smith's shop.

Mr. J. STEWART WALLACE, M.P., said it struck him as rather remarkable that the use of steel for carriage building should be deprecated, when it was being so largely used for many other purposes instead of iron, as being more economical and having a longer life. Of course there was a great distinction between steel and cast-iron, and as to the crystallisation which had been spoken of, he should like to hear it further explained. He thought hidden flaws might

occur in any metal, and could be tested for in steel as well as in iron. He gathered from the paper that in America workmen of different nationalities were to be found side by side in the same shop, while the English trade unions would not allow of this. If so, it was well it should be known, but he had always understood that the great object of trade unions was to maintain the rate of wages, and that they did not care what nationality a man belonged to if this were preserved. He quite agreed with Mr. Thrupp that the streets in America were very bad; a macadamised road outside a town was unknown, except near New Orleans, where there was something of the sort known as the Shell Drive. In very few even of the towns did you find macadamised roads, much less paved ones. The principal streets of most towns and all the country roads were simply tracks leading from one point to another, and did not deserve the name of road in the European sense. In many places you met with ruts six to eight inches deep; and it was marvellous how, in the Western States, the light buggies wore as they did. The reason they were turned out so cheaply, was because so much was done by machinery. He had seen wheel manufactories in South Bend and Annapolis, where all parts were made and put together by machinery much stronger than they could be by hand labour. The last speaker referred to an experience of 48 years, but for how long had there been any experience of electric welding? That was being very generally used now in America; and the experience in welding the tyres, or shoes of wheels, had been long enough to show that it was superior to the old system. He was assured by a first-class firm that the breakages were not half per cent. He agreed that, if it were possible to import foreign goods, and sell them as English, that was a grave defect in the law, but he could assure them such was not the case. Any man who sold an article, representing it to be of English manufacture when it was not, could be brought up for fraud, and compelled to return the money; and if the English public would only put the question, no man of any responsibility would dare to make a false statement, knowing he was liable in damages for it. He had enjoyed the pleasure of travelling with Mr. Thrupp, when he went to America, and he understood that he was the sole European representative of this industry officially engaged at the Chicago Exhibition, which was no mean compliment, both to himself personally, and to the English coach-building trade.

Sir HENRY TRUEMAN WOOD said he might add a word or two on the subject of American roads. America was a large country, and what applied to one district, did not apply to another. Out in the West there were certainly no roads, in the European sense, outside the towns, the reason being that their place was taken by railways and tram-lines; but in the Eastern States there were most excellent roads, as good as any in England. So, also, with its cities.

Washington was magnificently paved, but that was a rare incident. In many of the Northern States one great difficulty in the way of good roads was the hardness of the winters, but, in most cases, the true reason was that suggested by Mr. Thrupp—the bad management of municipal matters—which was generally admitted. Another reason was that in all American cities, the majority of the traffic was carried on by means of tramways, and the cable-car was no respecter of persons or of their vehicles. The result was that light traffic was pretty well driven off the streets in the big towns. People in Chicago told you they took their lives in their hands when they went for a drive amongst all the cable-cars which went tearing up and down every street, and of course this prevented much use of cabs. He thought Mr. Thrupp had rather exaggerated the price charged for these vehicles, however. No one in New York ever thought of taking a cab, but in Philadelphia and Chicago there were plenty, and in the latter city the price was 2s. the first mile, and 1s. a mile afterwards, which, considering the value of money there, was not excessive. In Philadelphia also, he believed the charge was not extravagant.

Mr. G. N. HOOPER said there were one or two other points he should like to refer to. Firstly he desired to thank Mr. Thrupp for the trouble he had taken in connection with the Exhibition, which must have been enormous, seeing he had 500 exhibits to examine. It was the fashion in England, once, for the nobility to vie with one another in the expensiveness and beauty of their equipages; and the same sort of thing seemed now to prevail amongst the wealthy class in America, and this led to constant changes in fashion as to style, pattern, and colour, designers, both foreign and American, being constantly employed in devising new forms. In this country the object was rather to improve and refine on the old lines, and to perfect the mechanism. Attention had been called to the high wages and large profits, but it must be remembered that the cost of living was proportionately high, so that the wages did not go so far. Ball bearings for carriages had been mentioned, but he should like to know if they had been tried sufficiently to establish their suitability for everyday work, especially for persons who were very particular about not travelling in a carriage which rattled. He understood that the cost of keeping a carriage and a pair of horses in New York or Chicago was about £600 a year, or about double what it cost in London. With regard to the use of steel, he would state his experience. Some 35 years ago, when travelling by post-chaises was given up, there was a general desire to have carriages built lighter, and the use of steel was suggested as a means of accomplishing that object. He then consulted an experienced iron master, who agreed to furnish him with a steel which should not

be brittle, like spring steel, but tough, harder than iron, and yet capable of being welded. He used that to a considerable extent, both for internal work and for the under parts, but he found, after a few years, that the fracture of the steel in the under works was too frequent to be satisfactory, and he had to give it up on account of its getting crystallised. But that difficulty did not apply to the edge-plates of the body, and for this purpose the steel had been proved satisfactory, from the first down to the last pair of plates he had made. The axles of every carriage were subject to a great deal of continual vibration, and it was found by experience that this caused crystallisation of steel, so that after an axle had run so many thousand miles it was no longer safe; the same thing no doubt applied to carriages. He had employed French and German workmen and had found no difficulty in their working harmoniously with the English workmen. There had been a discussion in that room recently on the best materials for street paving, and he would remark that the more the roads were improved the more could they improve and lighten carriages. No doubt in time Americans would see the wisdom of spending more money on the roads, but of course in some parts they had great climatic differences to contend with. He had gone over one wheel factory in America, and was surprised at the efficiency and perfection of the machinery; it was far in advance of anything he had seen in England. The last point he would mention was the training of the workmen. Up to a recent time the labour of the boys and apprentices had been very unsatisfactory, but since the establishment of technical classes for carriage workmen, his firm had insisted on all their lads attending the classes, paying the fees for them. A register was kept of their attendances, and each year, before Christmas, he examined their work, and awarded prizes to those who had been most diligent and attentive. The result had been most satisfactory, and he found the lads behaved better and took more interest in their work.

Mr. ROBINSON asked if there had been sufficient experience of pneumatic tyres for carriages to enable it to be asserted that they were really practicable for this purpose, and whether they really rendered the riding easier, and made the life of a carriage longer. He should also like to know how much per annum it would cost to keep them in order.

The CHAIRMAN said it was no doubt his duty, as Master of the Worshipful Company of Coachmakers and Coach Harness Makers, to deliver a dissertation on coach-making and harness-making in America, but he should omit that, and confine himself to the more pleasing duty of proposing a vote of thanks to Mr. Thrupp for his excellent paper. He did not suppose any immediate result could arise from a deliberation of this kind, but if Mr. Thrupp had set the

ball rolling, he would deserve well of the trade in this country, and not badly of their brethren in America.

The vote of thanks having been carried unanimously,

Mr. THRUPE, in response, said he read a paper on the previous evening before the Institute of British Carriage Manufacturers, in which he had dealt with the carriages at the Chicago Exhibition, whilst on this occasion he had confined himself to the carriage trade generally. That would explain why he had not referred to the aluminium waggon. It was certainly interesting, but no one could say whether it would be successful until after a practical trial. He did not think the Ferris wheel had much to do with carriage-making. Mr. J. B. Brewster used steel edge-plates for his frames, and was proud of their success; but he was the only one in America who used them, and his brother makers complained that some of his carriages broke up through having those plates. He had referred to the use of steel chiefly in connection with the question of weight, because he got sick of people who came to his works and talked about saving weight by the use of steel instead of iron, and he wished to point out that in a carriage this could not be done. He must thank Mr. Stewart Wallace for his remarks, and especially for having introduced him to New York under very favourable auspices. The question of trades unions he would rather discuss with him in private; but his general experience was that Englishmen were not very fond of foreign workmen coming in. They preferred the work being done by their own people. If there were work enough for all British workmen, no doubt they would be willing to open their arms to foreigners. He could quite endorse what Sir Henry Wood had said about the roads, but with regard to the cab fares, he thought he must have succeeded in bargaining better than many other English visitors. He could not say that coach-makers had yet had any experience of pneumatic tyres, except for trotting sulkies on a race track, where they answered very well; but, until they had been tried on the road, he could not say anything about them. Rubber tyres were a great improvement to carriages, lessening wear and tear by reducing vibration, and consequently lessening the coach-maker's bill for repairs. The cost, for a four-wheel carriage, would be about £8 a year; and the extra comfort and saving was well worth it.

Miscellaneous.

TECHNICAL EDUCATION IN ITALY.

The schools of Italy are divided into three grades—elementary, secondary, and superior. The United

States Consul-General at Rome says that these grades are established by law, and the course of studies in each is fixed by a decree of the Minister of Public Instruction. The law of November, 1859, concerning public instruction, obliged the heads of families to cause their children between six and twelve years of age to be taught in the lower elementary course. As this law did not produce the desired results, a new law was enacted in 1877, which required that all children above six years of age who had not been instructed in the elementary course, either at home or in private schools, should be sent to the public commercial schools. This obligation continues until the children are nine years of age, and may be prolonged until they are ten if they do not show, on examination, a proficiency in the course. The course laid down for this grade includes a general idea of the duties of men and citizens, reading, writing, the elements of the Italian language, of arithmetic, of the metrical system, and of gymnastics. The secondary schools are divided into two classes—classical and technical. The secondary classical course is taught in the gymnasiums and lyceums. The secondary technical instruction is given in technical schools and institutes. These may be Governmental, commercial, provincial, incorporated, or private. The technical schools or institutes not under the immediate direction of the Government may be placed on the Government grade, or considered as of the same rank, when it is shown that they follow the rules and the courses of study established for the Government schools. These schools and institutes were established in Piedmont and Liguria in 1859; in Sicily, Tuscany, and the Marches in 1860-61; in Venetia in 1866, and, in 1870, throughout the whole of Italy. Professional maritime instruction is given in technical institutes for the mercantile marine. These may be either Governmental, provincial, commercial, incorporated, or private. The course established for the technical schools occupies three years, and that for the technical institutes four years. The following studies constitute the course of the technical schools:—Handwriting, theory and practice of accounts, ornamental and geometric drawing, geography, French language, Italian grammar, composition and literature, arithmetic and the use of logarithms, the rights and duties of citizens as regards the family and the public, the rights guaranteed by the State, moral duties towards neighbours, and political rights and duties, elements of natural philosophy, chemistry, and mineralogy, elements of natural history, botany, and zoology, ancient, Oriental, and Greek history, Italian history and gymnastics. The instruction is divided into two courses of two years each. That for the first two years must be followed by all the pupils, that for the last two years pertains to the special profession for which the pupil seeks to prepare himself. The technical institutes are divided into three sections—physics, mathematics, surveying, and the science of commerce and accounts. The

course in the nautical technical institute occupies five years, two of which are for the preparatory course, and for the last three years there are three sections, designed to fit the student as a captain, naval constructor, or naval engineer. In the technical schools the pupils pay the following sums:—Upon admission, 5 lire (about 4s.); annually, 10 lire (8s.); and upon graduating, 15 lire (12s.). In the technical institutes the pupils pay the following sums:—Upon admission, 40 lire (32s.); annually, 60 lire (48s.); and upon graduating, 75 lire (60s.). Provision is made for the gratuitous education of poor and deserving pupils, both in the schools and institutes.

Correspondence.

THE PASTEURIZATION OF MULTIVOLTINE SILKWORMS.

May I be allowed to point out in the *Society of Arts Journal*, whilst complimenting Mr. Wray on his paper (see *ante*, p. 127), that what he proposes to suggest for India was organised some time ago by the Government of India under Sir E. C. Buck, Secretary of Revenue and Agriculture at Berhampur, where there is a sericultural laboratory under the guidance and management of Mr. N. G. Mukerji, who studied the whole question under Pasteur in his laboratory at Paris, and also sericulture in Montpellier, in France, and also at Padua, in Italy. The results up to the present time are highly encouraging, and point to a greatly increased silk industry in the future for India.

THOMAS WARDLE.

General Notes.

FIRE EXTINCTION.—The Bologna Academy of Science has opened a competition of means for the extinction of fires; and some demonstrations with one of the substances entered were lately made in Paris. It is reported that, by means of the liquid, burning rags soaked in petroleum were extinguished; two large fir logs kindled by straw—one sprinkled with petroleum and the other not—were at once put out; as also were 100 kilogrammes (220 lbs.) of tar, and half that quantity of resin, brought into a state of complete ebullition.

BELGIAN PRIZE COMPETITION.—M. Louis Trasenster, the late Rector of Liège University, left by will a sum of money to the Association of Liège Engineers, to found a prize of 1,000 francs (£40), not confined to members of the Association, for the best work “bearing on an important point in the labour question,

chiefly connected with the mining, metallurgical, chemical, and mechanical industries, and containing well observed facts, with clear and practical views.” The competing papers, accompanied by a sealed note containing the name of the author, must be sent, before the 1st June, to the Secretary, Association des Ingénieurs de l’Ecole de Liège, Liège, Belgium.

MILAN UNITED EXHIBITIONS, 1894.—With reference to the notice of the United Exhibitions, to be held at Milan from May to October, 1894 (see *ante*, p. 31), further information respecting the National Exhibition of Wines and Olive Oils, and the International Exhibition of Machines relative to these industries, has been received from the Foreign-office, through the Science and Art Department. The limit of time in which demands for space can be made has been prolonged to the 31st January. A few copies of the Rules and Regulations, and of the forms of application for space have been received; and, so far as the supply will extend, copies can be obtained by intending exhibitors, on application in writing to the Secretary of the Society of Arts, John-street, Adelphi, W.C.

ITALIAN WINE PRODUCTION.—The *Economiste Française* says that reports have recently been addressed to the Italian Ministry of Agriculture by the prefects of the various provinces, upon the wine harvest of the country in 1893. According to these reports, the yield of Italian wine, in 1893, was estimated at 653,400,000 gallons; the yield of 1892 was estimated at 745,800,000 gallons; so there was a falling off, in 1893, of 92,400,000 gallons. The production, in 1893, according to district, was as follows:—Piedmont, 85,800,000; Lombardy, 30,800,000; Venetia, 35,200,000; Liguria, 8,688,800; Emilia, 62,524,000; the Marches and Umbria, 61,900,000; Tuscany, 87,736,000; Latium, 28,424,000; South Adriatic, 81,862,000; South Mediterranean, 67,122,000; Sicily, 90,442,000; and Sardinia, 13,000,000 gallons. The South Adriatic region produced 80,608,000 gallons less in 1893 than in 1892; the South Mediterranean, 27,720,000 less; and the Marches and Umbria, 7,700,000 gallons less. The regions producing more wine in 1893 than in 1892 were the following:—Piedmont, Lombardy, Venetia, Liguria, Emilia, Tuscany, Latium, and Sicily. The total area under vine cultivation in Italy amounts to 8,665,000 acres.

INDIGENOUS PRODUCTS OF BOLIVIA.—A French engineer, M. Henry, who has laid out the first road projected in the Yungas regions, reports that many natural products of Bolivia are lost through want of care and organisation, including dye-wood, of red, bottle-green, and violet hues, which stand the action of both light and water. While cotton grows spontaneously in large quantities, timber, for building or making furniture, mahogany, quinine, and an iron

wood, called "colo," abound in this region. So hard is this colo, that presses for packing coca leaves, including the screw, made of the wood, stand the greatest strains, are never worn out, and are not attacked by damp, dry heat, or insects. While these natural products might be imported with advantage from Bolivia, there is said to be an opening in that country for tools, arms, and agricultural implements, including presses.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock :—

JANUARY 31. — "Californian Wines." By CHARLES F. OLDHAM. MICHAEL CARTEIGHE, Vice-President of the Society, will preside.

FEBRUARY 7. — "Automatic Balance of Reciprocating Machinery, and the Prevention of Vibration." By W. WORBY BEAUMONT. SIR FREDERICK BRAMWELL, Bart., D.C.L., F.R.S., Deputy-Chairman of the Council, in the chair.

FEBRUARY 14. — "The St. Pancras Electric Light Installation." By HENRY ROBINSON, M.Inst.C.E.

FEBRUARY 21. — "Electric Signalling without Wires." By WM. HENRY PREECE, C.B., F.R.S. SIR RICHARD WEBSTER, G.C.M.G., Q.C., M.P., Chairman of the Council, will preside.

FEBRUARY 28. — "Rainfall Records in the British Isles." By G. J. SYMONS, F.R.S.

MARCH 7. — "Refrigerating Apparatus." By PROF. CARL LINDE.

Papers for which dates have not yet been fixed :—

"Reproduction of Colour by Photography." By CAPTAIN W. DE W. ABNEY, C.B., F.R.S.

"London Coal Gas and its Enrichment." By PROF. VIVIAN LEWES.

"Experiments in Aeronautics." By HIRAM S. MAXIM.

"Automatic Gem and Gold Separator." By WILLIAM S. LOCKHART.

"Application of Electricity to the Disinfection of Sewage." By MONS. HERMITE.

"Design Applied to Carpets." By ALEXANDER MILLAR."

INDIAN SECTION.

The meetings of February 15, March 8, April 26, and May 24, will be held at the Society of Arts; those of February 8, and March 19, at the Imperial Institute.

THURSDAY, FEBRUARY 8, at 4.30 p.m. — "Telegraphic Communication between England and India :

its Present Condition and Future Development." By E. O. WALKER, C.I.E., M.I.E.E., formerly of the Government of India Telegraph Department. SIR THOMAS SUTHERLAND, K.C.M.G., M.P., will preside.

THURSDAY, FEBRUARY 15, at 4.30 p.m. — "Experiences at the Court of Afghanistan." By JOHN A. GRAY, late Surgeon to His Highness Abdul Rahman Khan, Ameer of Afghanistan. The HON. GEORGE N. CURZON, M.P., will preside.

THURSDAY, MARCH 8, at 4.30 p.m. — "The Indian Currency." By J. BARR ROBERTSON.

MONDAY, MARCH 19, at 8.30 p.m. — "Indian Railway Extension : its Relation to the Trade of India and of the United Kingdom." By JOSEPH WALTON SIR JAMES KITSON, Bart., M.P., will preside.

THURSDAY, APRIL 26, at 4.30 p.m. — "Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh." By SIR AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieutenant-Governor of the North-West Provinces and Oudh.

THURSDAY, MAY 24, at 4.30. — "Chota Nagpore : its Mineral Wealth and its value to India." By J. F. HEWITT, late Bengal Civil Service. SIR ALEXANDER WILSON, formerly President of the Bengal Chamber of Commerce, will preside.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on Tuesdays, at Eight o'clock :—

FEBRUARY 20. — "The Antwerp Exhibition, 1894." By EDOUARD SEVE.

MARCH 6. — "Travels on the Zambesi." By MONS. FOA.

APRIL 17. — "Tasmania and the forthcoming Hobart International Exhibition, 1894-95." By J. F. ECHLIN.

MAY 1. — "Paraguay." By A. F. BAILLIE.

MAY 29. — "Education in Victoria." By Prof. C. H. PEARSON, M.A., LL.D.

APPLIED ART SECTION.

Tuesday Evenings, at Eight o'clock :—

JANUARY 30. — "The Adam Architecture in London." By PERCY FITZGERALD, M.A. Colonel ROBERT W. EDIS, F.S.A., will preside.

FEBRUARY 13. — "Modern Development of Illustrated Journalism." By HORACE TOWNSEND.

FEBRUARY 27. — "Goldsmiths' Work : Past and Present." By Mrs. PHILIP NEWMAN.

MARCH 13. —

APRIL 10.—“The Evolution of Decorative Art.”

By HENRY BALFOUR, M.A.

MAY 8.—“Pewter.” By J. STARKIE GARDNER.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

PROFESSOR FRANK CLOWES, D.Sc., “The Detection and Measurement of Inflammable Gas and Vapour in the Air.” Four Lectures.

LECTURE II.—JAN. 29.—Attempts to utilise diffusion and other physical processes—Liveing’s electrical indicator—Apparatus depending upon the alteration of volume caused by burning the gas—Apparatus depending on the measurement of volume of gas required to bring the mixture to the ignition point.

LECTURE III.—FEB. 5.—Employment of a large alcohol flame in a special lamp—Recent modifications—Application of a standard hydrogen flame in an ordinary illuminating safety-lamp—Attempts to use a small alcohol flame in an ordinary safety-lamp.

LECTURE IV.—FEB. 12.—Application of the standard hydrogen flame to the detection and measurement of petroleum vapour in tanks and other spaces—The test-chamber and apparatus for observing and measuring the indications of the above testing apparatus.

HUGH STANNUS, F.R.I.B.A., “The Decorative Treatment of Traditional Foliage.” Four Lectures.

February 19, 26; March 5, 12.

CAPTAIN W. DE W. ABNEY, C.B., F.R.S., “Photometry.” Three Lectures.

April 2, 9, 16.

HENRY CHARLES JENKINS, A.M.Inst.C.E. “Typewriting Machines.” Two Lectures.

April 30; May 7.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 29... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. Frank Clowes, “The Detection and Measurement of Inflammable Gas and Vapour in the Air.” (Lecture II.)

Imperial Institute, South Kensington, 8½ p.m. Mr. W. W. A. Fitzgerald, “The Resources of British East Africa.”

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Dr. K. Grossmann, “A Journey through Iceland.”

British Architects, 9, Conduit-street, W., 8 p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. R. W. Fraser, “Religious Mosques, Tombs, and Temples of India.”

TUESDAY, JAN. 30... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. Percy Fitzgerald, “The Adam Architecture in London.”

Anthropological, 3, Hanover-square, W., 8½ p.m. Mr. J. E. Budgett Meakin, “The People of Morocco.”

Royal Institution, Albemarle-street, W., 3 p.m.

Prof. Charles Stewart, “Locomotion and Fixation in Plants and Animals.” (Lecture III.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Paper by the late Mr. Percy Rickard, “Tunnels on the Dore and Chinley Railway.” 2. Mr. Boverton Redwood, “The Transport of Petroleum in Bulk.”

Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Dr. J. F. J. Sykes, “Elementary Physics.” (Lecture II.)

WEDNESDAY, JAN. 31... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Charles F. Oldham, “Californian Wines.”

British Astronomical, University College, W.C., 8 p.m.

THURSDAY, FEB. 1... Linnean, Burlington-house, W., 8 p.m.

1. Mr. Malcolm Laurie, “The Morphology of the Pedipalpi.” 2. Mr. W. West, “The Freshwater Algæ of the West Indies.”

Chemical, Burlington-house, W., 8 p.m. 1. Prof. McLeod, “Note on the Liberation of Chlorine by the Interaction of Potassium Chlorate and Manganese Dioxide.” 2. Mr. S. U. Pickering, “An Examination of some Recent Freezing Point Determinations.” 3. Dr. Collie and Mr. H. K. Le Sueur, “The Salts of Dehydracetic Acid.” 4. Dr. Collie, “A New Method of Preparing Carbon-Tetabromide.”

London Institution, Finsbury-circus, E.C., 9 p.m. Mr. Shelford Bidwell, “Some Optical Phenomena.”

Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. W. E. Church, “The Literary Art of Walter Savage Landor.”

Royal Institution, Albemarle-street, W., 8½ p.m. Rev. Canon Ainger, “The Life and Genius of Swift.” (Lecture III.)

Mechanical Engineers, 25, Great George-street, W., 7½ p.m. Annual Meeting. 1. Address by Prof. A. B. W. Kennedy, President. 2. Prof. T. Hudson Beare, “Research Committee on Marine-engine Trials: Abstract of results of Experiments on Six Steamers, and Conclusions drawn therefrom in regard to the efficiency of Marine Boilers and Engines.”

FRIDAY, FEB. 2... Mechanical Engineers, 25, Great George-street, W., 7½ p.m. Mr. Edward W. Anderson, “Description of the Grafton High speed Steam-engine.”

United Service Inst., Whitehall-yard, W., 3 p.m. Col. J. R. J. Jocelyn, “Some Aspects of Coast Defence.”

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Mr. T. J. Cobden Sanderson, “Bookbinding: its Processes and Ideal.”

Civil Engineers, 25, Great George-street, S.W., 7½ p.m. Mr. H. C. B. Campbell, “Survey of the Valley of the Vardar and the Plain of Karaferia in Macedonia.”

Geologists’ Association, University College, W.C., 7½ p.m. Annual Meeting. Presidential Address on “Geology in the Field and in the Study.”

Philological, University College, W.C., 8 p.m.

Queckett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Sir Douglas Galton, “Ventilation, Warming, and Lighting.”

SATURDAY, FEB. 3... Royal Institution, Albemarle-street, W., 3 p.m. Prof. W. H. Cummings, “English Schools of Musical Composition.” (Lecture III.)

Journal of the Society of Arts.

No. 2,150. VOL. XLII.

FRIDAY, FEBRUARY 2, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

On Monday evening, 29th January, Professor FRANK CLOWES, D.Sc., delivered the second of his course of Cantor Lectures on the "Detection and Measurement of Inflammable Gas and Vapour in the Air."

The lectures will be printed in the *Journal* during the summer recess.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by members on application to the Secretary.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied post free for 1s. 6d. each, on application to the Secretary.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday, January 30, 1894; Colonel ROBERT EDIS, F.S.A., in the chair.

The paper read was—

THE ADAM ARCHITECTURE IN LONDON.

BY PERCY FITZGERALD, M.A., F.S.A.

There are a few notable architects who have left their mark, as it were, upon this great city of ours, and whose work is to be recognised almost at a glance; such as Wren and his pupils: Sir W. Chambers, Sir John Soane, and Nash, the designer of the Regent's-park

plaster terraces and Regent-street; to say nothing of the modern Queen Anne fashions. But the architect most remarkable for a distinctly original style was assuredly Robert Adam and his brethren. And it is interesting that over a hundred years after his death we should be gathered here to-night to consider his works in this spacious building, designed by him in this large quarter of the Adelphi, also erected by him. Even the very ground upon which I stand was raised by him high in the air to the level of the Strand, from the low-lying shore of the Thames.

The Adams were a remarkable family. The father was a fashionable architect, and built a vast number of noblemen's mansions all over Scotland, which show good sense and excellent effect. His four sons—after whom the streets about us here are named, Robert, John, James, and William—were architects also, though one only, Robert, was the genius. It is remarkable that a single family should have thus engrossed the work of almost an entire century—the father during the first half, the sons during the latter.

Robert Adam was a clever, well-cultivated, aspiring young man, who received a University education. He had good connections and high patronage, and could have at once stepped into business; but he determined, first, to thoroughly cultivate his talent and form his style. In 1757, nearly 140 years ago, he set off on the grand tour, visiting Rome and other Italian cities. But the old remains—amphitheatres, temples, baths, forums, and the rest—did not supply him with what he wanted. What he sought was some monument of a residential kind, which would furnish him with ideas as to how the ancients treated their domestic architecture, and whose system he might adapt to the mansions of the opulent lords at home.

At Rome he had been struck by the arrangement and ornamentation of the baths of Titus and Diocletian, and this suggested to him a direction for his studies. He had learned that in Dalmatia, on the coast opposite Venice, there was a very remarkable and striking building of this kind—the Palace of Diocletian, in the Bay of Spalatro. This he determined to visit and study thoroughly. Accordingly, he took with him some artists, with an ingenious French architect, called Clerisseau, and set sail for Dalmatia.

There is really much romance, and even poetry, associated with this place, and the story of it. The Emperor Diocletian, when he

abdicated, built himself a vast palace here, the sight of which almost confounds the traveller. It was an enormous pile some 600 feet square, containing temples, and halls, and gates, and arcades. So well preserved is the city through all its vicissitudes, that the great temple of Jupiter is, to this hour, used with little alteration, as the Cathedral; while the temple of Æsculapius serves as a baptistery. It has fortunately been preserved in excellent condition, owing to the fact that the inhabitants have built their houses in the palace itself, and utilised the walls for their own dwellings.

This fascinating monument has been visited by many travellers, both French and English, such as the late Lady Strangford, Sir Gordon Williams, and Mr. Jackson the architect, who all seem to have felt the charm of the place; and we can conceive the feelings of the aspiring young architect as he sailed into that Dalmatian bay. But the most striking feature of the whole, and which most impressed the imagination of the young architect, was the great terrace on the sea; a most picturesque and astonishing thing, which must have inspired any architect of true feeling. It suggested to him another monumental work which he carried out on his return. He remained here nearly two months, studying and making the most careful drawings, until he had thoroughly permeated himself with the entire spirit of the place. The result we have in a magnificent *Atlas folio*, which was issued under the highest patronage, not of England only, but of all Europe.

So little is known now-a-days of Adam's work, that I fancy the average superficially informed man in the street, if asked about it, would reply, "Yes; I know Portland-place, and all that; and there is the Adelphi." Yet it will indeed hardly be credited what an amount of Adam's work is to be found, not in London alone, but all over the three kingdoms. I have taken great pains, and made careful search, and have been able to compile the following catalogue of his works, the first, I fancy, that has been made:—

The Adelphi; Portland-place, with Mansfield-street; a portion of Harley-street; Stratford-place, in Oxford-street; Finsbury-square; portions of Dover-street and Grafton-street; Spring-gardens; one side of Portman-square; Portman-street; Hamilton-place; George-street, Westminster; Bedford-square; Gower-street; Cumberland-place; Seymour-street; Bryanston-square; mansions in Whitehall: Gwydyr-house and, possibly, Whitehall-

place; houses in Berkeley-square and Hart-street; the long terraces at Kensington, known as Upper and Lower Phillimore-place; Fitzroy-square; York-place; houses in Weymouth-street; in Devonshire-street; in Manchester-square; the Duke of Cambridge's-house, Park-lane; houses in Soho-square; in Bruton-street; and in Russell-square; terraces in the Walworth and Old Kent-roads; and at Kennington. Besides a number of buildings which have escaped search, or which have been swept away.

Thus much for streets. His mansions in and about London, and in the provinces, are many. There are:—Montagu-house, in Portman-square; Harewood-house, in Hanover-square; the Admiralty-screen, Whitehall; a wing of Northumberland-house (now pulled down); Lansdowne-house, Berkeley-square; the great building of the Sunday School Society, in Serjeant's-inn, Fleet-street; mansions in St. James's-square; Chandos-house; Foley-house; Boodle's Club, St. James's-street; "British" Coffee-house, now destroyed; Coutts's bank in the Strand; and a large club-house in Piccadilly.

Outside London there are Kenwood, Lord Mansfield's mansion at Hampstead; Osterley-house, Lord Jersey's fine mansion at Brentford; Sion-house at Isleworth, restored and decorated by him; a fine house in Conduit-street, opposite Messrs. Lewis and Allenby's; additions to the United Service Institution; Lord Fife's house at Whitehall, decorated by him; a Gothic ceiling, designed for Horace Walpole, no doubt for Strawberry-hill. During his life there was a proposal to re-erect the Houses of Parliament, and he furnished some elaborate designs in the conventional Greek style; a central portico with wings.

About the middle of the last century, most of the noblemen and gentry were busy building mansions and castles; and Adam was almost invariably called in. In Scotland he was largely employed, and Edinburgh can boast numbers of public buildings, squares, and terraces from his hand. There are also fine mansions in Dublin and Bath, of his work. Nearly all the great towns, such as Glasgow and Newcastle, can boast some fine specimens. At the time of his death he had actually in hand no less than eight public buildings and twenty-five great mansions—an amount of commissions enough to make the mouth of even a reasonable architect of our times water. It is altogether an astounding record of work.

At this point we may pause to ask what are the principles of this Adam's style, which strikes us as something apart from all others. Most of us will recognise an Adam front, or an Adam doorway and window, or Adam furniture, chimney-piece, grate, &c., the principles are carried out so logically. There are many I know who object to the style; it has been called tame, prim, mincing and insipid; but this arises from its thorough correctness and propriety. Elmes, father of the architect of St. George's-hall, speaks of "the finicking finish" of his work, and "the depraved school of the lower and middle empire," which he introduced. The late Mr. Fergusson says his style was of the "thinnest and most tawdry class." But he concedes its originality and correctness, which are great merits, and to some of his works gives unstinted praise. Perfect correctness and reserve will always appear prim and "finicking" to those who are accustomed to extravagance.

The first merit of Adam's style we trace to an exquisite sense of proportion. In our day this principle is rather set aside. We cannot blame our architects for this, for we live in a highly utilitarian age, and what is required is the utmost accommodation the ground will admit of.

Little attention is given now to the beautiful proportions of the column, which, in Adam's hands, had a special grace. It is not generally known that the chief columns in London, that in Trafalgar-square, and the Duke of York's, are both shorter by some twenty or thirty feet than they ought to be, owing to the funds having failed. The Victoria Tower is also shorter by a whole story than it should be, with the result that it seems squat and stunted. Even in the common doorways and porticos we observe this inattention to the graces of proportion. An ordinary Grosvenor-square or Brook-street portico is a gross, sprawling thing, made by rule of thumb, out of all proportion to the door and to the house itself. A modern London portico is usually made to discharge the double duty of a portico and balcony—always a mean and ineffectual shift. A balcony is a fine thing, as we can see from the Venetian patterns; and a portico is a fine and attractive thing. But this hybrid balcony-portico destroys the function of each, for the balcony ceases to be a balcony, and becomes really only the top of the portico, while the latter has to be raised high, so as to reach the level of the window, and fails to give shelter. Such is Nemesis. In Adam's doorways there

is a placid grace and reserve, a perfect refinement of treatment, not obtrusive, and yet asserting itself, with the delicate ornamentation of the garlands. The whole is most pleasing. The portico of Chandos-house has the same airiness and grace.

I have often speculated why it is that a column out of proportion should seem shorter or taller than it really is. I fancy the reason is that the eye that is trained to correct the proportion expects the column to be higher or thicker, and supplies the portion that is wanting. Or it may be that when the proportion of the column is correct, the eye travels upward swiftly; but when it is thicker than it should be, the eye is delayed and drawn aside, and the feeling of height lessened. If we were to widen and widen the column till it became a square, all sense of height and breadth would disappear, as the object would be as broad as it is long. Garrick was often ridiculed on the score of his being such a little man, notably by Quin, the actor, who was a broad, unwieldy man. Hogarth undertook to prove by a drawing that Garrick was really tall, owing to his good proportions, and of the same height as Quin himself.

Another direction in which Adam's delicacy was shown was in mouldings and cornices. friezes, medallions, ovals, &c. In nothing is expression and feeling so much shown as in the contour of a moulding; it is akin to style in literature, or to the graces we see in "the human face divine." It would be thought, for instance, that no grace or beauty could be added to a dead wall of brick surrounding a garden, such as we see at Berkeley-square, before Lansdowne-house. A rude coping of stone might be added to preserve it from the wet. Yet every time we pass it, we recognise Adam's graceful touch—he has refined this homely wall. There is the feeling of proportion in the suitable height of the wall, the delicately moulded coping, and the base. The keynote to the whole is in the oval ornament on the pier, of which he thought so highly, that he had it beautifully engraved, as a thing of beauty.

Another principle was proportion in the materials. The material that he had to use for his building was what is called the common "stock bricks," ill-fashioned and ill-blended, for patent bricks did not then exist. Between this poor, homely material and the heavy stone "dressings," pillars, pediments, there was an incompatibility. The garnishing thus becomes too heavy, and the framing more

substantial than the picture itself. Feeling this incongruity, he used the greatest restraint in his additions. Before his day, the fashion was for huge, massive porticos, pediments and columns, which impeded the light, and overpowered the main building. Adam always made his pediments a portion of the façade, out-lining it, as it were, on a surface; his columns were always "engaged," that is, sunk in the wall, so that only half is shown. This gives a sort of homogeneous air, and makes the whole one mass. But a more important element was his use of a wonderful material—a cement—invented by one Liardot, a Swiss clergyman, which had the enduring character of stone, and all the flexibility of stucco. It is impossible to say too much in praise of this material. It had none of the meanness or degrading air of stucco, but improved with years; and there are specimens now to be seen, over 130 years after, which, for sharpness and cleanliness can not be distinguished from stone. Out of this material he fashioned those pilasters which are an unvarying note of the Adam style. These he embroidered over with a decoration, his favourite pattern being the graceful honeysuckle sprays, a form which he brought from Dalmatia.

He must have used thousands of tons of this material in his ceilings and other forms of ornament, and they are as perfect to this day as when they were set up.

Horace Walpole always spoke sarcastically of Adam's work, though he occasionally employed him. He likened these decorated pillars to a soldier's old coat, with its lacings down the seams; and praising another work, he said, "It is grand, not tawdry, nor larded, nor embroidered with shred and remnants and clinquant, like the harlequinades of Adam, which never let the eye rest a moment."

Adam may, indeed, be said to have "glorified the arch" wherever he could; where others had squares or oblongs, he had curves. He would bend the fronts of houses into bows; he would curve the dividing wall between a front and back room; he would arch his ceilings. The backs of his houses are agreeably diversified by assuming such forms. Thus the rear of the houses in Stratford-place is so agreeably broken, as to offer something almost picturesque; and who shall say that this is not a most agreeable entertainment for the eye? The arch suggests ease and security, and also a sort of movement, as from the centre to the circumference.

Things square or oblong suggest weakness and angularity.

But the most striking and original feature in his system was his system of *fenestration*, as it was called—his arrangement of the windows—by means of which he imparted a variety and beauty to his façades. In common brick dwelling-houses we find the windows treated in a negative fashion; they are simply holes in the wall, placed in rows. Adam's aim was to remove this air of monotony. He made them express what was within, and furnish as much light as possible. To this end he would group three windows together in the centre, arching the middle one, and separating them by columns. The building in which we are assembled is really a fine one, as well as a typical specimen of his system, and shows all its features.

The grouped windows in the middle signify to those outside that there is a great room behind, while the archway over it supplies the idea of strength and security, which so large an opening might imperil. We should notice here the graceful, compact, business-like doorway, and the dignity of the pediment and pillars, which harmonise with and do not overpower the brick. This triple window he brought with him from Spalatro, and used in almost every building that he erected. It might almost be considered his trade mark. It will be recognised in the Sala Regia, only he transported it from the ground to the second storey, and of a door made a window.

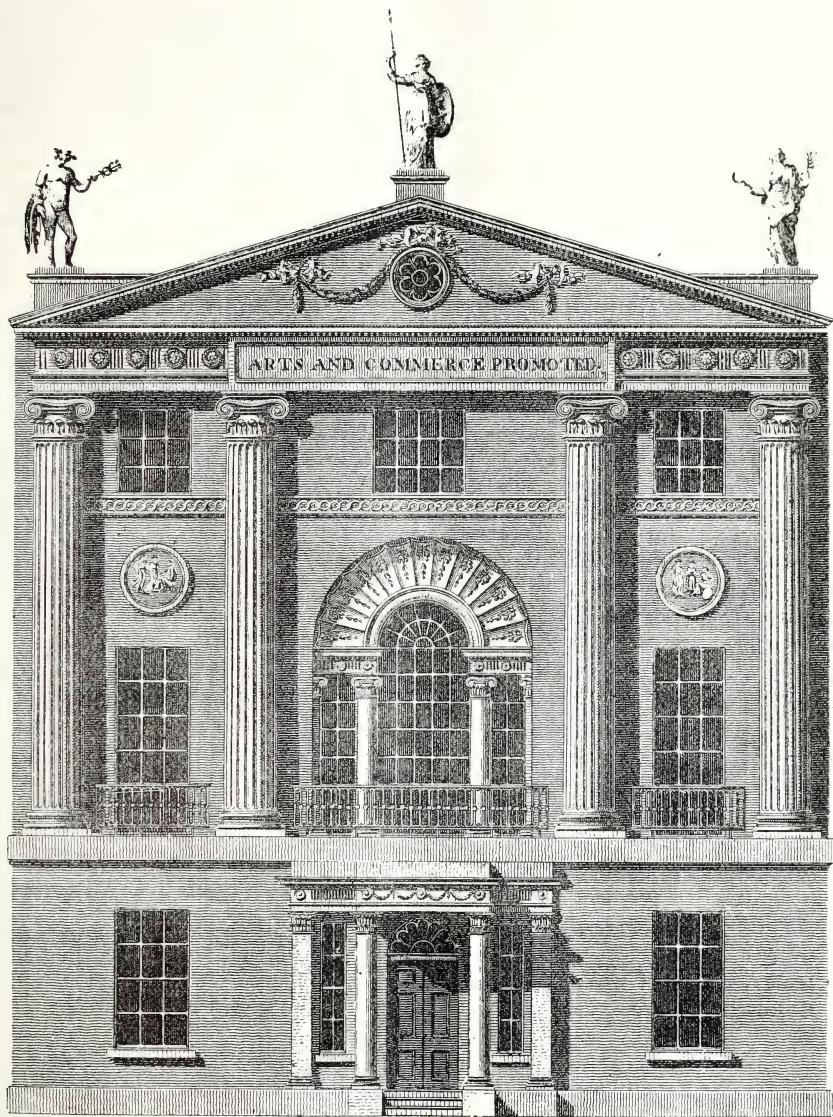
There was a deeper meaning in his lunette, or arched window, a feature of which he was very fond, and there is scarcely a building of his without it. The lunette was a segment of a circle, not a half-circle, but about a third—a delicate distinction which an architect will appreciate—and I have no doubt it could be expressed by a mathematical formula. This device he used not only in windows, but for the fanlights of his doorways, adopting this smaller segment, which, as it were, elongated the area, and was more graceful.

Adam often gave a sort of finish to his houses by placing a lunette window in the upper, and even lowest storey, by way of finish or apex. This, too, he also introduced from Spalatro. With such devices, lunettes, grouped windows, columns, small niches, and always elegant doorways, he contrived to impart an air of animation and expression to the otherwise monotonous face of a brick house.

In Cockspur-street, where Mr. Stanford's map-shop is now, there was a building

known as "The British Coffee-house," which used to be admired—a very pleasing composition, and which the architect himself was pleased with, as an elaborate engraving of it is given in his great book. This sort of design is clearly a reminiscence

of Spalatro, though it might not appear so at first sight; but in the ruined Golden Gate of the Palace, the architect will recognise the design, for here are the lunettes and niches, and the general disposition of the whole façade.



J. Tugwell Sc.

ELEVATION OF THE HOUSE OF THE SOCIETY OF ARTS, JOHN-STREET, ADELPHI.
DESIGNED BY ROBERT ADAM.

But his last and best work, Gosford-house, in Scotland, shows what picturesque animation he could produce by the arrangement of the windows. This design is full of expression and even vivacity. Each portion of the house attracts by some fresh variety, and claims

attention for its expression and movement. The three great windows in the centre suggest lightness and airiness, the ornamentation is graceful and charming; even the little semi-circular window next the ground has a piquancy, and, small as it is, asserts itself and

catches the eye, like the little terrier in Landseer's picture of "Dignity and Impudence."

Another note of the Adam style is the sincerity and truthfulness of the designs. Ornament or decoration is not introduced for the sake of ornament, but simply as a part of the expression. Another, the admirable workmanship, the perfect construction always found in the best specimens of old native or foreign work. The current work of our time is not remarkable for this merit, as it is associated with the general demand and with cheapness. These qualities of sincerity and truthfulness, of course, are the marks and tokens of all good architecture, just as Mr. Guinness, the eminent porter brewer, when asked what was his secret, replied that his secret was the using only good materials. In short, we may always know an Adam house by these signs and tokens. By the triple window in the centre; by the elaborate fanlight over the door, and its elongated, lunette shape; by the breadth of the windows, the double doors, the ironwork, railings, knocker even, and the rest.

Descending from general principles, we now come to his particular works. His first really important enterprise was the daring and ambitious scheme of the Adelphi—that is the raising on the low-lying shore of the river a large and handsome quarter which should be on a level with the Strand.

My friend, Mr. Wheatley, has described this enterprise in an interesting monograph; and has dwelt particularly on the enormous underground structures which support the streets. These vaultings and arches are quite Cyclopean in their character. The very areas of the terrace are like houses, and a couple of stories in depth. The design of the terrace itself, thus raised in the air with its side streets, is really imposing; we at once recognise that the inspiration came from the palace at Spalatro. Most of us will recall the fine effect when it overhung the river, from which it is now removed a long way. The houses which were occupied by Garrick, and other persons of consideration, are fine and spacious, and the rooms beautifully proportioned.

The Adam buildings have suffered so much from alterations and additions, that it is difficult now to form a correct idea of their original appearance. The pilasters and ornamental work are usually painted over, thus destroying the original natural tone of the stucco, and the effective contrast between it and the brick. In this quarter of the Adelphi we

have even a shop designed by him—Mr. Attenborough's.

In St. James's-street we often pass by, without notice, a rather uninteresting building, Boodle's Club, but where the great central window clearly proclaims its purpose—a large chamber within where the members could assemble. Mr. Fergusson bestows almost extravagant praise on the University-buildings in Edinburgh, which he commends for their perfect good sense and sincerity of expression. "The centre is bold, and well-marked, and ornamental, without any feature so gigantic as to overpower the other portions." The wings are properly subordinate, and the arch at the bottom supplies a little piquancy. The cornice, he objects, is rather too slight. But on the whole, he says, "there are few buildings so truthful, and so well balanced in design, or so satisfactory."

It will be interesting now to see what Adam has done in the case of a private mansion. In St. James's-square, on the club-house side, is found one of the most pleasing and effective of his works—the residence of Lady Williams-Wynn. Here he seems to have been allowed a free hand, and the result is most satisfactory. This stately house is at once solid and ornamental. We have his "large" style, and, at the same time, all those special ornamental graces in trifles, of which he was a master. There are arches over the rectangular windows on every story which, as the house is of stone, suggests strength. They really do duty in the way of support. The area windows have very marked arches a foot deep, which is fitting, as they have to bear the whole weight of the mansion. The arches of the parlour story are less pronounced, as they have less weight to carry; those of the drawing-room still less; while the top story, having no weight to carry, has no arches. This treatment gives—as in the case of Gosford-house—an animation and life to the face of the house. Then there the doorway with its graceful fanlight and expanding steps; Adam excelled in fanlights; though modern owners invariably remove them and substitute plate-glass. Instead of bold mouldings on his doors, Adam was partial to a sort of fluted pattern, which supplied richness of detail. The original knockers even, of his design, are here. Note also the fan-like flowing line of the stair railings and the balconies, which have a logical purpose, simply as a support to rest on, as you look

out of the windows. I pass over the fine original stair, the beautiful chambers with their graceful alcoves crossed by columns, the charming little dressing-rooms, and circular or hexagonal chambers. The whole is a masterpiece that will give pleasure to any one of true taste.

The Adams built a vast number of these stately mansions or palaces for the nobility. The most important of these was Keddestone, —almost a palace—and which Dr. Johnson said would serve admirably for a court of justice. It is of a rather conventional pattern, and shows little of his peculiarities. Luton Hoo, which he built for Lord Bute, and which now belongs to the Danish Minister's wife, is rather conventional, though there is a pleasing piquancy in the semi-circular portico.

But we find the most favourite—almost stereotyped—Adam type in Lansdowne-house, Berkeley-square; that is, an ordinary square mansion, with wings, decorated merely with a pediment and pillars, and with wings added, originally built for Lord Bute, a valuable patron, who then built two palaces from the designs of the same architect. Of this type, also, is Kenwood, Lord Mansfield's place at Highgate. They are what might be called good, workmanlike patterns.

At the bottom of Stratford-place is a house of similar pattern, very pleasing, from its correct proportion and its elegant colonnade. This harmonises with the place itself. The whole was built for Lord Aldborough, for whom Adam also built a more magnificent house in Dublin, one wing of which was a theatre, the other a chapel. It is now used as a barrack.

Adam's touch was always light and elegant, and was shown even in altering or re-modelling existing structures. There was an ugly building in Whitehall—the old Admiralty—with an ungainly portico, the columns of which are out of all proportion; and for this he supplied a screen, which most of us will notice as we pass by every day. I was always puzzled at the praises lavished on this work, which was extolled as a great classical work. Its three openings seemed unmeaning enough. Examining it closely, I found that the pillars had been removed to make these side entrances, and that the architecture had been completely spoiled by the alterations, which destroyed its character as a screen. The old picture of the structure shows how different it looked when it was a real screen.

But this is not all. The original design with its decorations seems really an elaborate and most effective one, and its present condition is a good instance of the way architects suffer from official interference with their designs; for all the ornamentation was suppressed.

I will give some other specimens of this delicate touch as applied to trifles. Adam built a bank for Mr. Coutts, the banker, in this quarter of the Adelphi. It was desired that he should connect the buildings by a bridge which crossed the street. We know what flimsy things these usually are—glass passages, ungraceful and uncomfortable to look at or to cross. Adam felt that, in the case of a bank, solidity and an air of solid security were the proper associations, and his bridge accordingly has an air of perfect propriety, and is almost Venetian in character. The eye rests on it with perfect satisfaction. The adjoining buildings have the same correctness, and even picturesqueness, expressing exactly, with their circular windows, the notion of the strong room of a bank. In such matters as stabling, coach-houses, and yards, he always shows the same simplicity and effective design.

In Mansfield-street, out of Portland-place, is to be seen a little back yard with a coach-house that was inconveniently close to the back drawing-room. Not much can be made of a back yard, but with a few touches Adam made it an object pleasing to view. The whole is pleasing, the curves very graceful. Close beside Inigo Jones's Banqueting-hall, in Whitehall, stands the old dilapidated United Service Institution. I have discovered that this was the joint work of two eminent architects, Sir John Vanbrugh, the builder of Blenheim and Castle Howard, and of Adam, who supplied the two rather insignificant wings. Here he certainly failed, just as he did at Finsbury-square, which is a rather deplorable piece of work.

Sometimes to add an attraction to the front of an old house he would design a little lodge and railing. These ornaments were always effective. Other architects deal with such things in a rather ambitious way, and make Greek temples in miniature, like the Park lodges. Just as Goldsmith said of Johnson, that if he were to write a fable on the little fishes he would make them talk like whales. There is a specimen of this class of work in front of the War-office, which shows power of expression, and another in front of Ashburnham-house.

Another of his *hors d'œuvres* was a showy gateway which he designed for Sion-house, at Isleworth. We know the usual pattern of the nobleman's gateway; the lodge, the piers, the heavy railings and the rest. His theory was that the passer-by was entitled to such a display for his entertainment, even though it were a little theatrical.

The Adams were great contractors, and concerned in many building speculations, such as the familiar Portland-place, and the adjoining streets; Fitzroy-square, Finsbury-square, George-street, Westminster, and other streets. As Mr. Wyatt Papworth, the Curator

of the Soane Museum, has pointed out to me, the money for some of these ventures was found by that eminent miser, Mr. John Elwes. No one can form an idea of the original appearance of Portland-place, it has been so much altered; stories having been added to almost every house, the pilasters painted over, the pediments even removed. The interior spacious chambers remain, with their fine chimney-pieces and stucco ornaments. They were disposed in architectural blocks, the central ones being the most marked and most prominent. No. 25, now occupied by Captain Blake, Adam built for himself, and no doubt he



BRIDGE IN WILLIAM-STREET, ADELPHI, DESIGNED BY ROBERT ADAM.

made it as attractive as possible. Even as it stands, there is a pleasant correctness and reserve in the treatment.

Fitzroy-square, which I daresay few Londoners have visited, and some do not know, is a picturesque and architectural monument, worthy of Bath itself, which is saying much. Two sides are of stone, garnished with his favourite stucco friezes, which harmonise admirably. But it is now in a forlorn and dilapidated condition. It was a favourite principle of his to treat a row of houses like this as though it were one long, single building. It has been objected

to, on æsthetic grounds, that this treatment is an architectural fiction or deception, as it is really only a number of houses grouped together. But it may be said that when a whole terrace of houses is thus erected at the same time, it is really one great mansion, for they are under one roof, and each has not its own four walls, but is separated from its neighbour merely by a party-wall. It is, in fact, one great house partitioned off into compartments. In Portland-place we find one of his pleasing mansions, Foley-house, the back of which has an almost theatrical grace. There is something of the Italian villa here.

Adam also exhibited his talents in theatre-building—always attractive to an architect—and designed the New Drury-lane Theatre for Garrick, a sensible and expressive bit of work conceived in a classical spirit. The interior showed all the regular and correct Adam ornamentation, and can be recognised at once as his work. It was engraved by Bartolozzi, and the figures on the stage are portraits of the manager and his wife. I believe there are only two instances of his having designed a church, that of Mistley, in Essex—and this is not a very successful work—and that of St. George, in Edinburgh. The ecclesiastical style was, perhaps, not in his way. He also designed tombs, some of which are in Westminster Abbey.

But while thus contributing to the beauty of the street and the country, the architect was even more brilliantly successful in his arrangement of interiors. He wished to offer a complete contrast to the style then prevailing—to the flat ceilings and enormous, ponderous cornices, huge monumental chimney-pieces—which were called Tabernacles; all in imitation of the treatment of rooms in palaces. They were dark and gloomy chambers, heavy in treatment, of which we can see specimens in Grosvenor and Portman-squares. Nothing could be more original and imposing than his grand suites of rooms, staircases, and lobbies. We may, however, wonder how he got so much out of the limited space. From this nice sense of proportion they always suggest the idea of grandeur and size. In his mansions he introduced the fine arched, not coved, ceilings profusely decorated; and he would separate a chamber from a lobby by an opening supported by pillars. There were also oval and circular rooms.

Most striking are the original curves of the ceilings, the arched recesses at the side, the pillared vista at the end, the chimney-piece, the urn, and the chaste reserve of the frieze in such abundance of decoration. My friend, Mr. Sala, says justly that a lovelier room does not exist than the circular breakfast-room at Lansdowne-house.

Such was the house of Lord Derby, which was unnecessarily pulled down, many years ago, and a modern mansion erected in its stead. But even a greater surprise would be the result if we visited the library of Sion-house, the Duke of Northumberland's mansion at Isleworth, when this splendid elaborately decorated apartment would greet us. The luxuriance of the decoration here is quite

astonishing. Here, again, we have perfect wealth of decoration, and yet it scarcely seems overcharged. It will be noted that the shelves make part of the construction, being sunk in the wall, which is fitting enough, as the "motive" of the room is books. The shelves or bookcases, therefore, should not be treated as pieces of furniture.

In the decoration of the ceilings, Adam displayed an amazing fertility of grace and fancy. It is said, however, that here he was largely indebted to Pergolesi, an Italian he brought from Italy, and who has published his own designs in a handsome volume. But on comparing these I find a greater formality and less freedom than characterise Adam's work. These ceilings were wrought in his favourite stucco, in light relief, and tinted in pale colours. These designs Adam styles "grotesque," in the strict meaning of the word, that is, such as were discovered in the old Roman grottoes. They are of the same type as that used by Raffaele's *logge* in the Vatican. This tinting and colouring of the raised work does not seem to me very successful. I have seen in old mansions beautiful designs of this pattern, flowing over the wall, half Pompeian, half grotesque. Indeed it is a difficult matter to know how to treat it. I have also seen some rooms elaborately gilt, which produced an air of heaviness, and emphasized the details too much. In the Soane Museum some thirty or more volumes of Adam's designs are preserved. I suppose there are some thousands of these drawings, some of them beautifully finished, and proving the astonishing power of the architect.

It is difficult to trace the origin of the decorative details in which he showed such a lavish profusion of invention. There is at times something Eastern in the complexity of the patterns. His borders leave a suggestion of the shawl pattern or Turkey carpet. He was fond of the repetition of a spade-shaped motive. Yet, notwithstanding this multiplicity of detail, there is nothing niggling, and breadth and richness of effect is secured without confusion. No one understands better that canon of decoration which produces the effect of detail by broad touches without the aid of details.

In a striking passage Mr. Ruskin has explained this. He is praising one of Turner's exquisite vignettes in Rogers's "Italy"—a little picture only a couple of inches square, representing the Doge's Palace at Venice—and he points out the rich effect of the carvings on the

arches; but on using a magnifying glass we find that there is no attempt at representing carvings or details, but that the effect of such is conveyed by a number of artful strokes, dots, and the like. This proves that the exact simulation of details does not produce the effect of detail.

Adam kept this principle well in view, and his decorations, when seen at a distance, seem to take more effective shape, and do not become confused. The border which runs round the top of the hall of the Society of Arts has this effect.

The favourite garland, which he so regularly employed as a decoration, was not the common realistic imitation, but the refined abstraction of a garland. He sought merely the elegant repetition of the form—the refined form of the garland—the flowing drooping, and rising of the line which is so pleasing to the eye. Even in his houses of an unpretending class, built for “jobbing” purposes, he did not omit to add his favourite graces and decorations. Thus a narrow hall he would set off by a rather elegant frieze, the details of which wore his favourite bull’s head and rosettes, disposed alternately.

Adam had a fine eye for circular and oval forms, and there are refinements in these that would escape less delicate natures. Some of his oval medallions show a most refined feeling. Considering the affinity there is between the Adam style and that of Wedgwood, it is curious that we find no suggestion of any relation between the two men. One would have thought that artists so devoted to beautiful form and contours, in vases and other directions, must have been brought into contact; but I doubt if Wedgwood could have found any legitimate place in Adam’s system. Adam was too conscientious to allow his chimney-pieces to be mere frameworks for Wedgwood plaques and medallions, which would have diverted the attention from the general effect.

We find, however, from Miss Gerard’s recent life of Angelica Kauffmann, that that artist’s work, as well as Cipriani’s and Zucchi’s, was often found in company with Adams’. I doubt if even this co-operation is harmonious; and the delicate tracery and light tints seem to contrast too violently with the dark heavy tones of a centre painted in oils.

In such decorative adornment as ceilings, and chimney-pieces and doors, our architect seemed to expend all his graces. An Adam door is a beautifully proportioned thing, on which the eye rests with pleasure. They are

nearly always double—what the French call *portes battans*—which are always, the true proportion. A single door, is too broad in proportion to its height, and too great a burden to be balanced on hinges. They were usually of mahogany, with fluted or flrilled work, instead of mouldings, and of the finest workmanship. A friend of my own was decorating his house, at the West-end, when his builder told him of some of these doors, which belonged to an Adam house that had just been demolished. He secured them. I never enter that mansion without being inspired by the sight of them, for they have really a dignified and ennobling effect. With arches over them, and a graceful entablature, they become most effective ornaments. The balance between height and breadth is perfect.

It will be noted what grace and originality is shown in the treatment of even the door handles and door furniture, which are truly elegant. The keyhole and handle are united by a graceful garland.

An Adam chimney-piece is a very choice and *recherché* thing, finds its way to the dealers’ shops, and now fetches high prices. The proprietor building a new house carefully removes the old chimney-pieces. They are really exquisite works of art. Adam treated them constructively, much as one would a doorway or a window. It forms, really, an entrance to the fireplace, and as an opening is made in the wall, there must be a construction to support the mass above. Nor did he adopt the false principle of making the top do duty as a broad shelf, to carry all manner of articles. The top was merely broad enough to furnish a cornice; hence the effect is quite architectural. They were usually made of the finest statuary marble, and the carving is exquisite. I have seen some specimens in noblemen’s houses, with inlaid marbles, lapis lazuli, and set off by gilt ormolu that were astonishing.

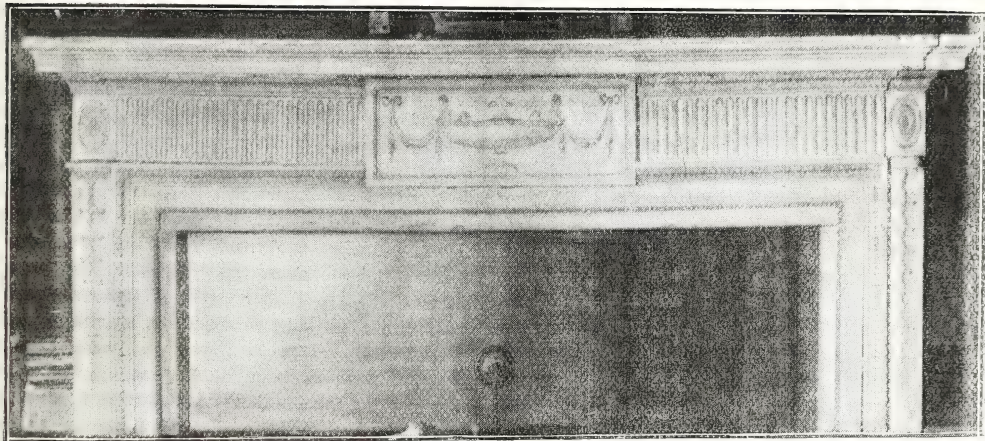
I find, in Adam’s notes, that for one house in Portland-place he made separate designs for every chimney-piece, even for that of the garret, nearly thirty in number. The same originally extended to his fireplaces, the ironwork of which is in perfect harmony with the rest.

I must now hurry on to another department which further displays the genius of these famous brothers. As I have said, they not only built the house, decorated it from top to bottom, but they furnished it entirely. It might be said, indeed, that they were the “Maple and Co.” of the era, only displaying

more careful art than does that popular firm. In the house that I described in St. James's-square, they supplied designs for everything, chairs, tables, mirrors, girandoles, wine-coolers, tea-caddies, knife-boxes, carpets, hangings, room-papers, all the silver, even to the cruet-stands, and it must be said every one of these articles is distinguished by an elegance of design that is surprising. Their room-papers were charming, both for tint and pattern, and I am glad to say there is a firm in Marylebone, Messrs. Woollams, who have reproduced many of the forms. The silver is designed rather after the Wedgwood-Bentley pattern, vases of classical shape, the work very slightly raised. We know what little design is usually expended on what is called door furniture—handles, plates, key-

holes, &c.—yet even the garrets are furnished in this respect with his elegant designs.

Adam furniture is now much esteemed and sought, and is as much admired as sought. It is truly elegant in design and construction, and has much of the lightness, combined with strength, which distinguishes French makers such as Reisner. His chairs—often graceful, oval designs—were intended as a protest against the broad, sinuous, and somewhat coarse lines of the Chippendale chair. The Empire furniture often suggests the Adam in its outlines, and naturally enough, as it came from the same source. Much of Adam's art was in designing his furniture for the room, and even for the place in the room, it was to occupy. Thus his mantel-piece mirror, with the attendant girandoles, made part of



MANTELPiece IN THE MEETING ROOM OF THE SOCIETY OF ARTS.

the decorations of the fireplace. When he came to combine a mirror with a console table he was equally logical. Nothing can exceed the airy grace of these console tables, with their delicate limbs. He would combine, too, with his table and mirror, tripod candelabra.

His elegant fancy seemed to revel in these fanciful arrangements, and his imagination never seemed to fail him. In his designs for iron-work, we find the same sense of propriety and gracefulness. There is a reserve and perfect sense of the capabilities of the material. His railings, balconies, and lamps all show this correct and appropriate feeling. The balconies are delicate and geometrical in the details; they scarcely suggest the notion of cast iron. They can be seen in abundance all over London. He had two or three favourite

patterns for his balconies, all simple in design and suitable to the material, and contrasting with the tortuous and florid attempts of our time. He was equally successful in his area railings. Instead of the meagre top rail, pierced with holes, in which the vertical rails were fixed, he used a sort of ribbon with a pattern, which was better for the construction, and more romantically effective. On these railings were reared the standards for lamps and the extinguishers, a picturesque addition to the ornamentation of a house. These were in pure and correct taste, somewhat Greek in pattern.

Another article in which Adam displayed his ingenious variety of fancy were knockers. Though knockers have practically "gone out," we find the Adam knocker retained in

many instances; a tribute, no doubt, to their artistic merit. He has many patterns of these, and showed himself conscientious in designing for each separate occasion. In this he resembled that admirable and versatile architect, whose loss we have to lament, Mr. Sedding, whose every effort shows the same spirit of thoughtfulness and fancy. He has a little "trade knocker," as it might be called, in the shape of a lion's head—full of expression. It suggests Stevens, the sculptor's, little lion on the railing outside the British Museum; a sketch, but so quaint and spirited, that artists often come and model it.

Of all the furniture found in modern drawing-rooms, perhaps the least art is expended upon the pianoforte. It pretends to no more than being a ponderous case of machinery. Adam designed a harpsichord, in coloured woods, for no less a personage than the Empress of Russia, and he made a rather elegant thing of it. Our architect even condescended to such things as sedan-chairs, and designed one for Queen Charlotte.

Such, then, is a review of Adam's work—imperfect, no doubt—but prompted by sincere admiration and diligent searchings.

The paper was illustrated by a series of lantern slides, showing a large number of elevations of the houses designed by Robert Adam, and specimens of interiors of buildings, ceilings, and other decorations, as well as furniture of the Adam's style.

Mr. Batsford kindly lent for exhibition at the meeting two volumes of the original folios of Adam's works in architecture, and a copy of his reproductions from some of the plates in this book.

DISCUSSION.

The CHAIRMAN said, as an architect, living in one of the squares in which Adam worked, he had, for some twenty-five years past, noticed one special type of his design, which he did not altogether admire. Although he made a terrace of houses more or less to resemble one house, which might have some advantages, it was somewhat unpleasant to anyone who had to live in one of them to find that half a window belonged to him and half to his neighbour, especially if the window was circular. His view of Adam—and he had seen many of his houses, and had the good fortune to have had to deal professionally with some of them—was that he was much more successful in the smaller detail, especially in his ceilings and the internal decoration, than he was in the general elevation, because he seemed to lose sight of the first attribute of all good architecture, especially domestic, that the external

work should be always made subservient to the internal use. We lived in an age in which it was first of all desirable to have comfort of all kinds and general home arrangements. We did not want windows placed so high that we could not look out of them, or so low that they were in the way of the furniture. A house must, first, be useful, and, next, beautiful. So far as his knowledge of Adam's work went, the internal work—more especially the ceilings—was extremely beautiful, but he was not prepared to go quite so far as Mr. Fitzgerald in his admiration of the general lines of the palace of Diocletian, which was not, in his opinion, one of the greatest triumphs of ancient art. No doubt Adam did a vast amount of valuable work which was very interesting in its time, though he did not think it was so good as that of Stuart—Athenian Stuart, as he was called—because that was much more fine in all its characteristics, and also more able in its architectural details. So far as decorative detail was concerned, they were much indebted to Robert Adam. How far that sort of thing could be done now, architects knew best. A theatre might be designed in all the abundance of fancy which Adam displayed, but the County Council might intervene and spoil it; and, as to carrying out all the internal decorations in the way they had heard described, it was now absolutely impossible. There were now emporia, so-called, at which you could buy furniture of all dates and all kinds—good, bad, and indifferent as to design—of each particular kind. There were cliques and individual types of art at the present day, all fancying they knew better than other people, and working in their own special grooves. It was only given to those who were rich to indulge in those beautiful chimney-pieces which were left in the old houses, and were now worth large sums of money; and he was glad to see that educated people bought them. He was quite sure they would all agree in passing a cordial vote of thanks to Mr. Fitzgerald for his very valuable paper.

Mr. H. H. STATHAM said there was a great deal in the paper with which he sympathised, though he could not quite join in all the enthusiasm of the reader; not that he quarrelled with him on that account, for no one could give a good account of any man unless he had some enthusiasm for him. He had always admired Adam for two things: first, because he was a likeable, honest, hard-working man of fine personal character; and, secondly, because he was one of the very few architects of whom it could be said that, to some extent, he invented a style—or, rather, sub-style—of his own. The origin of it was all to be found, more or less, in Roman architecture; but he invented a treatment which had his own stamp upon it, and, so far, was original. He agreed with all that had been said as to the delicacy of grace of his internal decoration; but, even with regard to that there was a limit, as there was a constant repe-

tion of the same motives ; and, in his favourite forms of wreaths, &c., he never once looked to nature for the basis of his ornament. It was all the repetition of conventional, graceful form, which, though graceful, was cold ; you never saw the mark of real genius in it. He had one annoying trick of using festoons everywhere, sometimes quite contrary to all the principles of decorative art. A festoon was a form fashioned by the action of gravitation on something hanging loose ; but Adam was so fond of it that he put it horizontally over his ceilings, which was a perfect contradiction of the principle from which that ornament evolved. When you came to the outside, he was still like a decorator and furniture designer ; he never rose to any expression of greatness and solidity. A great deal was said about his manner of using pilasters on the face of his houses, and it was to his credit that he used these things with great elegance ; but, after all, that system was recognised now as one of the great falsities of architecture. The face of that very building, of which a photograph had been shown, represented architecturally a colonnade, an order which ought to mark a single story ; but between it you saw the windows, which marked the two stories, into which the front was really divided, and you could not call that good architecture. Then, that peculiar form of window—of which he was so fond—was not a bad one once in a way, but when you found it everywhere where there was a chance, it became monotonous, and showed deficiency of invention. They must regard him as a very capable architect in the use of the materials which he chose, but not as a man of great genius or imagination. He represented probably the feeling for art of his own day—cold classic grace, or elegance without imagination—but they would all unite in acknowledging that he was worthy of the attention Mr. Fitzgerald had bestowed upon him.

Mr. J. HUNTER DONALDSON said Adam had the conspicuous merit of knowing what he wanted to do, and he evinced in all he did a sense which, in his time, was much wanting, both internally and externally—that of unity. The great defect up to his time in decoration and furnishing was that it was not conceived in any spirit of unity, and, consequently, was incongruous in character. Throughout France particularly you now found that all men of wealth who spent money on decorations and furniture had a sense of the value of unity of design. In almost any room in any decently furnished house in France you would see one particular style represented—usually a French style—to which, perhaps, they adhered rather too tenaciously, but, at all events, you had the satisfaction of knowing that the woodwork, ironwork, steel, curtains, chairs, &c., were all governed by the one idea of representing a particular style. This was very pleasing, and he regretted that it was not so generally observed in England. It would always be a credit to Adam that he drew public attention

to this unity, and gave such emphatic expression to it in his internal decoration. Mr. Statham's criticism was very sound, and much of Adam's work was open to the objections named, but, still, when you looked at some of his buildings, you saw at once that he had a particular idea in view, to which he sought to give expression in an intelligible, artistic, and reasoned form, and that in itself was a matter of value. It was a matter of regret that even now, with all the advantages of modern education, the sense of unity in internal decoration was very inadequate, and if Mr. Fitzgerald had not done anything more than call attention to that, he would deserve their hearty thanks.

Mr. HAGREEN said that artists and people of refined feeling must see the truth of what had been said about Adam's work. Where he derived his inspiration, or his particular notion of decorating the outside, was not so important, seeing that he made such vast improvements on what existed before his time. In the present day, he feared, the same success was hardly to be hoped for, in consequence of the way in which materials were bought and designs rushed, and there was no consistency, there was not the opportunity Adam had of designing everything throughout a house.

Mr. HUGH STANNUS, having referred to the exceedingly interesting character of the paper, drew attention to two large volumes of Adam's designs, which were placed on the table for inspection, which would assist to illustrate the admirable critical account which had been given of Adam's work. The view of the house in Weymouth-street showed how thoroughly Adam had mastered the academic or scholastic tradition of his art. Parts of the wall were thin, and parts thick ; and this emphasised, in a very suggestive manner, the two functions which a wall had to perform. A wall had to sustain and support the floors and the roof, and it also had to enclose the rooms ; and this was admirably shown in the house, the thicker part being the supporting part, and the thinner part the enclosing. With all respect and deference to that great man he could not help feeling that Adam's style was an imported one. He had spent five years in Italy, and had employed a great number of Italian draughtsmen to copy decorations ; and those connected with the style :—Sheraton, Angelica Kauffmann, Cipriani, Bartolozzi, Pergolesi, and Piranesi (who preceded him)—formed quite a band of workers, and the Adam style was the sum total of those working together. He did not mean to say that Adam used them as "Ghosts," but at the same time it must be borne in mind that those wonderful drawings in the Soane Museum, and all those hundreds of buildings up and down the country, could not have been the work of

any one man, however industrious, unless he had numbers of enthusiastic and capable workers to assist him. He entirely agreed with the view that his work was rather that of the decorator than the architect, what Pugin would have called the "inside-out" style. He once said that some designs were of two styles, the "inside-out" style and the "outside-in" style; and he would probably have classed Adam's among the former. The decoration of those pilasters, and much of his beautiful work, showed no appreciation of the difference between the outside of a building and the inside. The thin relief was very delightful, but still it was more suited to the bright, sunny, clear climate of Italy than that of England, and it was therefore an imported style. It might also be said that it was not a carved style, but a painted style rendered in relief. The beauty of carved ornament was that it covered over the surface rather than showed the interspaces; in the well-known Trojan scroll, for instance, the spaces between ornament were much less than the ornament itself. That was the characteristic of carved ornament—much ornament and little ground. But in painted ornament, there should be light, delicate work, with little bits of colour laid on with a brush; and such was Adam's decoration. In some of his later designs—some of the decoration of cabinets—that delicacy was carried to an extent which it would be hard to equal, and certainly could not be surpassed; and there it was in its right place. *qua* colour, and not *qua* relief. It had been a great pleasure to him to see Adam's work again; and to hear the paper, which really recalled to him his early training in art; and he felt they were under a great debt of obligation to Mr. Fitzgerald for the admirable manner in which he had treated his subject.

Mr. H. B. WHEATLEY said it was desirable to point out, as they were then in an Adam room, that the decoration of the roof was later work; but the frieze just above the pictures was Adam's, and it was very curious to notice that it was almost identical with that on the upper part of Attenborough's house at the corner of Adam-street. One point connected with these decorations was the frequency of their repetition. They were much indebted to Mr. Fitzgerald for the immense amount of fresh information he had brought together. Adam's style was now the fashion, and most people knew more or less about it; but still it would be a revelation to a great many that there were so large a number of houses in London which owned him for their architect. It was worthy of note that, of the very few specimens of old street architecture left in London, a large proportion were by Adam. If they did not answer the highest demands of the architect, they were certainly very pleasing to the eye, and a great relief to the ordinary brick buildings. The United Service Institution had a very interesting history. It was now one of the most dirty

and miserable looking buildings in London. It was built originally by Vanbrugh, and was the occasion of some satirical lines by Swift, in which the work of "Vitruvius the Second" is likened to "a goose pie," and it was, therefore, an object of literary interest. In consequence of the additions made by Adam it had been generally overlooked. On account of its association with Swift and the famous architect-author Vanbrugh they would be sorry to lose it, although it certainly could not be commended for its beauty.

The vote of thanks having been passed unanimously,

Mr. FITZGERALD briefly replied, saying that he was glad to see there was some unanimity of ideas with regard to Adam's work, still he was afraid there was a deal of truth in what the Chairman had said as to the principles which now prevailed, and that they were very likely to overpower these more correct and pure principles of Adam, and on the whole there was very little chance, except amongst the enlightened few, that they would make very great way; still they must hope for the best.

Mr. WYATT PAPWORTH writes:—It will be a disappointment to me not to be present at the lecture to-night, on so interesting a subject to an architect as the "Adam Architecture." Having had the pleasure of seeing Mr. Fitzgerald at Sir John Soane's Museum, he will, no doubt, mention the many volumes existing here of drawings by Robert Adam, especially some "compositions," founded upon the studies at the Palace of Diocletian at Spalato, beautiful in drawing and colouring, in Indian ink. These could readily be seen by visitors in March, from the early part of which month the museum is open four days a week. No doubt it was this edifice that gave them the style they adopted, and perhaps the coloured work was obtained from the ancient decorated stucco work at Rome. They in their ceilings appear to have adopted two systems of decoration—stucco work, and painting, perhaps only. As far as stucco work is concerned, it must not be forgotten that it was practised earlier by architects, and some beautiful stucco ceilings may be seen, the work of the followers of Inigo Jones (died 1652), which, even as late as 1766, when Isaac Ware died, are equal in design and execution to the Adam work. For contemporary criticism, the following extract from a private letter, written by Sir William Chambers to Lord Grantham, August, 1773, is amusing; it may not have come before Mr. Fitzgerald:—"Messieurs Adam have lately published a book of their ornaments, with a preface, rather presumptuous, as I am told, for I have not yet read the book, in which they boast of having first brought the true style of decoration into England, and that

all the architects of the present day are only servile copyers of their excellence. I do not agree with them in the first of these positions, and can produce many proofs against the last — among others, Melbourne-house, decorated in a manner almost diametrically opposite to their's; and more, as I flatter myself, in the true style, as approaching nearer to the most approved style of the ancients." The whole of this gossiping letter is printed in the "Journal of the Royal Institute of British Architects," 1892-3, p. 484.

Sir John Soane's Museum,
January 30, 1894.

EIGHTH ORDINARY MEETING.

Wednesday, January 31, 1894; MICHAEL CARTEIGHE, Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Buchanan, James, 62, Dale-street, Tradeston, Glasgow.

Brown, George Turville, 34, Great George-street, S.W.

McCarthy, W., 21, Great Elm-road, Bromley, Kent.

Morison, Bruce, 20, Clanricarde-gardens, W.

Neal, William Phené, Pinner's-hall, Old Broad-street, E.C.

Ross, William A., Belfast, Ireland.

The following candidates were balloted for and duly elected members of the Society:—

Barber, Amzi Lorenzo, Belmont, Washington, U.S.A., and care of J. W. Privité, 2, Crosby-square, E.C.

Barry, John, M.P., Kirkcaldy, Fifeshire.

Bayard, Francis Campbell, 2, Cloisters, Temple, E.C., and Wallington, Surrey.

Bloomer, Thomas, 36, Springfield-road, St. John's-wood, N.W.

Bright, Fred E., Cleveland, Ohio, U.S.A., and Hotel Victoria, W.C.

Caldwell, William, Murray-street, Paisley.

Holmes, George Edward, London-road, Derby.

Jackson, Edward Francis, 49, Rathbone-place, W.

John, W. Goscombe, 34, Finchley-road, St. John's-wood, N.W.

Laidlay, William J., B.A., LL.B., 50, Circus-road, St. John's-wood, N.W.

Lansdown, George Arthur, 5, Warwick-street, Charing-cross, S.W., and The Briars, Wimbledon.

May, Francis John Charles, 25, Compton-avenue, Brighton.

Norman, James Noel, 34, Great George-street, S.W.

Payne, R. Horne, 1, Chapel-place South, Mayfair, W.

Peele, Edmund Cresswell, Cyngfeld, Shrewsbury.

Rickett, J. Compton, King's-cross, W.C.

Roberts, George, 379, Bramall-lane, Sheffield.

Slocombe, Fred, Fair View, Holder's-hill, Hendon, N.W.

Startin, James, M.B., 18, Harley-street, Cavendish-square, W.

The paper read was—

CALIFORNIA WINES.

BY CHARLES F. OLDHAM.

I have been asked to place before you to-night some facts respecting California wines, with which my personal connection with the wine-producing districts of that country have made me acquainted. I may, perhaps, suitably commence by reminding you that California is situated on the Pacific Coast of North America, the name having been first applied to a peninsula on the west coast of Mexico, but being gradually extended to a considerable portion of the adjoining continent. California of the present day extends from parallel 32° 28' to parallel 42° north latitude. In round numbers the State is 700 miles long and 250 miles wide; the coast-line extends over 900 miles. In the year 1850 it was constituted one of the United States of America.

California was visited in 1767 by a body of Franciscan friars from Mexico, who made settlements there, establishing various missions, and planting around them the grape vine: a variety known in after times as the "mission" grape, which the fathers, according to tradition, had brought from Spain; but it is more probable that the mission grape was a seedling, propagated by them, as no similar one seems to be known in Spain. The vine is indigenous to California, and it is worthy of note, that in France a great part of the vineyards have been replanted with California stock, on which the European varieties have been grafted. The reason for this having been done, is that the native wild vine of California is able to resist the phylloxera, a disease which threatened, at one time, to exterminate the French vineyards.

California runs almost due north and south, and has a great variety of climates, so that it is possible to produce there almost every variety of wine.

About the year 1860, the wine industry in California first began to receive attention, from a business point of view, and in 1861, three State Viticultural Commissioners were appointed to report on the best methods of promoting the improvement of grape culture. One of these Commissioners came to Europe, and after visiting all the most important viti-

cultural districts, he made a lengthy report on the methods of European vine cultivation and wine making, taking back with him to California some 200,000 grape-vine cuttings and rooted vines of every obtainable variety, to be obtained in Europe, Asia Minor, Persia, and Egypt. These were afterwards gradually distributed throughout the State, and formed a nucleus for experimental purposes. Among them is said to have been the grape—now so well known in California—called Zinfandel, supposed to be a Hungarian variety; but there are evidences that this grape was already growing in the country.

The industry made slow, but fairly satisfactory progress till 1870, when the production of wine had become greater than the demand for it, and then it began to flag, and finally it became so unsatisfactory in 1875, that many vineyards were either abandoned, uprooted, or replaced by orchards and grain fields. In 1879, however, the demand for California wines was equal to the supply, and a renewed interest was then awakened in viticulture, and the wines—although very crude—found a ready market.

Up to 1880 there were very few vine-growers in California who appreciated the value of any variety of grape, other than that of the old mission, which, although a heavy bearer, yielded, as a rule, very poor wine; and to this cause, more than to any other, must be attributed the bad reputation which California wines had earned, previous to the more general planting of other and finer varieties.

Up to the beginning of 1880, the viticultural interest of the country was in a state of chaos. There was woeful lack of knowledge, a want of system, no beaten paths to follow, and but a few acknowledged authorities from whom information could be obtained. The State Legislature, recognising the condition of affairs, and being fully satisfied that there was a great future before the wine industry of California, created in March 1880 a State Board of Viticulture, and provided the necessary funds. The State was then divided into seven viticultural districts, each having a representative on the Board—the representatives being chosen from men who were practically conversant with viticulture in all its many branches. Two extra Commissioners were added to represent the State as a whole. These nine Commissioners immediately set to work to gather and distribute all information which was likely to be serviceable to the industry, and, in 1881, they issued a report, which proved to be of the greatest value.

They arranged for a large number of cuttings of the finest European varieties of grapes being imported into, and planted in California; and by degrees the old mission grape was grafted out, as vine-growers began to appreciate the importance of the new importations. Moreover, experimental stations were formed, with the object of determining the sorts which were most likely to succeed in the different districts.

It is unquestionable that the soil and climate of California are exceptionally well suited for the production of wine, and it is not surprising that, with the improved methods of cultivation and of wine making, the quality of California wines rapidly improved, and that men of wealth and experience embarked in the business.

In 1880, not more than about 35,000 acres were under vine cultivation, and of the grapes grown only 20 per cent. were of imported varieties, the rest being mission; whereas in 1888, there were some 150,000 acres bearing vines, and 90 per cent. of these consisted of the finest European varieties; and the number of vine-growers had by this time increased to some 6,000, with a capital of £13,000,000 sterling. In the year 1877, the total amount of wine made in California was 4,000,000 gallons, whereas in 1886 it had increased to 18,000,000, and is now about 20,000,000 gallons per annum.

Large though this quantity is for a new country, it is comparatively small to what can, and no doubt will, be produced as the demand increases. If the prices for wine show a tendency to rise to any appreciable extent, fresh planting of vineyards will immediately take place, and this will bring up the supply to the level of the demand. For this reason, good California wines should be attainable, at a moderate cost, for many years to come.

Having cited the foregoing figures, it is interesting to note that the total amount of wine made in Australia up to the present time, averages about 3,000,000 gallons per annum.

One peculiarity of the viticultural industry in California is, that owing to the diversity of climate, it is possible to make wine of almost every kind. The coast range, for a considerable distance north and south of San Francisco, may be regarded as perhaps the best part of the State, according to present experience, for the production of natural dry red and white wines, such as those of the

claret, burgundy, hock and sauterne types. This district comprises the counties of Santa Cruz, Santa Clara, Napa, Sonoma, San Mateo, Livermore, &c. Farther south, around Los Angeles, and in some of the hotter parts, such as Fresno, excellent port, sherry, and sweet wine types could be produced. Brandy can also be made in almost any part of the State, as the Folle Blanche grape—formerly so celebrated in the cognac district of France—grows in California to great perfection. The climate in the best dry wine districts of California being very uniform, it is exceptionally well adapted for vine cultivation.

In Europe great difficulties have often to be contended with, on account of the seasons being very variable and uncertain. It is quite the exception to get a really fine vintage. When the weather in Europe is propitious throughout the season, the vintage is an unusually good one, and the wine of that year becomes famous. In California the seasons are much more regular and consequently it is easier to maintain a uniform quality year after year.

For the production of wine, soil and climate are the great factors; nationality has nothing to do with the result. We have, in the present day, so many facilities for learning all particulars regarding these things, that the supposition, which has, to a great extent, prevailed until late years, that light red wine could only be produced in France, must now give way to the hard facts of natural history.

Some of the great French works on viticulture give a chemical analysis of many notable vineyards in France, the conspicuous feature of which is the very large proportion of insoluble matter—viz., gravel and sand—that compose the soil.

The California State Agricultural College has also made a chemical analysis of many of the vineyards in California, the result being the important discovery that the soil in some of the best vineyards of the two countries is strikingly similar, the ingredients of each being almost identical.

Now as to climate. That of California is acknowledged to be almost perfect for vine culture, owing to its regularity, and to the bright sunny weather which can be depended upon, from the beginning of June, when the fruit sets to the close of the vintage in October. One has only to turn to those French newspapers which are devoted exclusively to the viticultural industry, to see how much importance is attached in France,

to the state of the weather during the growing season, and how much settled, sunny weather is appreciated at that time.

With these facts before us, and the knowledge that the same varieties of grapes are grown in each country, it is only natural to expect that good wine and good brandy can also be made in California, especially as no expense or labour has been spared to obtain the most approved appliances and machinery for the purposes of wine-making and distillation.

A large number of French, German, Italian, and Swiss wine makers have settled in California, and it cannot be doubted but that the experience and training of these men—combined with the wealth, energy, and enterprise of the Americans and English who have made California their home—is having a very marked effect on the wine industry.

California is far from being the only part of America where wine is produced, some considerable quantity being made in the Eastern States—notably in Ohio and New York. These wines are, however, of a totally different character, being made entirely from native grapes, no European varieties growing east of the Rocky Mountains. Undoubtedly the best wines made in California, up to the present time, are the natural dry red and white varieties, such as those of the claret, burgundy, sauterne, hock and chablis types.

As has been already stated, these wines are made from the same variety of grapes as in Europe; but in California they develop somewhat different characteristics. For instance, the white wines, made from the riesling or hock grapes, although resembling, in many respects, the German hocks, have very much less acidity, and, as a rule, more body. This is owing, no doubt, to the fact that these grapes thoroughly ripen in California, whereas in Germany they scarcely ever do so: it is often impracticable to pick the grapes in the latter country until November, and sometimes even December.

Sauterne types, in California, are chiefly made from the Semillon and Sauvignon-Blanc varieties, the wines produced being generally very clean and soft, and without any of the excessive sweetness so often found in the fine French sauternes.

The chablis, or white Burgundy types, also succeed very well in California, the wines being delicate, and free from acidity. Upon the whole, these three types of white wine are probably the best which are produced in California.

Of natural dry red wines, the Burgundy types are perhaps the best, having generally a nice ruby colour, a good deal of body, and a fine fruity flavour. The *petit pinot*, or Burgundy grape, grows there to perfection.

Amongst the claret types, there are a great many different kinds produced in California, nearly all the famous Bordeaux grapes being grown there extensively. The Zinfandel grape—already mentioned—also makes a claret type of wine, and, as it bears very heavily, the wine made from it is generally obtainable at a moderate price.

In certain districts, this grape produces an agreeable light table wine, soft and smooth. It comes to maturity early, and does not require to be kept in cask, or in bottle, nearly so long as other and finer sorts. Most of the better claret types are made by the judicious blending of well-known Médoc varieties of grapes. Claret made from the Cabernet Franc grape alone, produces, in certain parts of the State, a fine wine of good colour and flavour, with great firmness, developing splendidly with age.

The Cabernet Sauvignon grape—famous as being the variety chiefly used in making the celebrated “Château Lafite” of France—is now grown to a considerable extent in California, and produces a very big, rich wine; but it takes a long time to mature, and is chiefly valuable for blending with lighter sorts, to which it gives great character.

As regards the sparkling wines of California, there is at present only one firm which has been very successful in dealing with them. Many years, and large sums of money, have been devoted to making experiments, and to bringing this wine to its present state of maturity. It has peculiarities of its own, but is exceedingly clean, and free from acidity, and develops well with age. It is made in precisely the same manner as French sparkling wines, but unlike many of the French champagnes, no brandy is used in liqueuring it.

Up to the present time, the people in California have not given as much care and study to the production of port and sherry types, as they have to the natural dry red and white wines. There is no reason, however, why—in some parts of the country—they should not succeed equally well with them; and even now it is possible, with care and attention, to obtain some very fair wines of the port and sherry types.

There are several other varieties of sweet wines made in California, some of them being

peculiar to the country, for which there is a large demand in America—such as Angelica, Muscat and Tokay; the latter, although a good wine of its sort, does not closely resemble its Hungarian namesake.

Undoubtedly one of the most successful of California's productions is its brandy. Brandy means the liquid obtained by distilling the fermented juice of the grape, viz., wine; the quality of the brandy depending not only on its distillation, but on the variety of wine from which it is made.

The fine French brandies, so famous in former years, were distilled almost entirely from wine, made from the Folle Blanche grape, with a small proportion of Colombard. Owing to the phylloxera, these varieties have become almost extinct in the cognac district of France, but in California they thrive to perfection, and, as they bear abundantly, fine brandy can be made from them, in the latter State, at a very reasonable price.

Brandy when first made is clear and colourless. It is usually kept in oak casks to mature, the spirit dissolving out the colouring matter of the wood, and so acquiring a light sherry tint.

The idea very generally exists that brandy, to be good, should be deep in colour; for this reason burnt sugar is often added. The fine Folle Blanche brandies of California are, however, left in their natural condition, and are therefore somewhat light in colour.

California being situated on the far-off Pacific coast of North America, the remark is often made that the cost of bringing wine from San Francisco to London or to the Eastern States of America, must be very heavy. In point of fact, however, this is not the case. The freight on wine from San Francisco to London is about the same as it is from Spain or Portugal to London. There are many routes available, the cheapest, and most generally used being that of sailing ship round the Horn, a voyage of about four months. The keeping qualities of these wines are such that they improve by a long voyage. Another route by which large quantities of these wines and brandies are shipped is from San Francisco to Panama by steamer, thence by rail across the Isthmus, and thence by steamer again to New York for Europe. This route usually takes from two to three months, and is also very inexpensive. In cases when speed in transit is of the greatest importance, the wines are sent by regular freight trains from San Francisco to New York, a distance of about

4,000 miles, which takes a maximum time of ten days. The cost of freight by rail is subject to a good deal of fluctuation, and is dependent upon the competition existing at the time. For a considerable while however, the rate of freight on wine from San Francisco to New York by rail has only been $1\frac{1}{2}$ d. per gallon.

Cooperage is a very important particular in the handling and maturing of wine, owing to the fact that both wine and brandy very quickly take on a bad taste, if put into impure or unsuitable casks. In some wine-producing countries, it is very difficult and expensive to obtain good casks in sufficient numbers, Australia, especially, suffering a good deal in this particular. In California, however, an almost unlimited supply of the finest oak casks can be had at a very moderate price. In order to give some idea of the quality and strength of these California barrels, it is only necessary to mention that when done with they can be sold in England at a good price, for shipment to other wine countries, where the supply of good oak wood is scarce.

Almost invariably wine-producing countries are large wine-consuming countries, and California is no exception to this rule. Some 8,000,000 gallons of its own wine are consumed annually in California; the remaining 12,000,000 gallons sold chiefly to those parts of America where there is a large foreign population—such as New Orleans, New York, &c., Americans, as a nation, being very small wine drinkers. There is, also, a continuously growing export trade in California wines all over the world, and ever increasing quantities are finding their way to England, where they are taking a recognised position, being appreciated by the public for their purity and wholesomeness.

To many of those who have given me their kind attention during the reading of this short paper, the facts I have set forth may possibly be novel, and even surprising. Certain it is, however, that in this favoured province of North America, all the essential conditions for the production of both red and white wines of the highest qualities exist to a marked degree, viz., pre-eminently suitable soil; congenial and equable, though at the same time varied climates, and facilities for cheap transit to all parts of the old and the new world.

That California, with its manifold advantages in all these respects, is rapidly taking its proper place as one of the principal wine-producing countries in the world, is undoubted, and is not surprising to those who know the

facts of the case. The sooner these facts become more widely known, the more quickly will California wines attain, more especially in this country, the high place in public estimation to which their excellent qualities assuredly entitle them.

DISCUSSION.

Mr. R. BANNISTER said this paper took him back to the history of the Australian grape production, for the viticulturists in both countries had gone through the same experience. They started with a certain kind of grape, and thought they could produce a particular kind of wine as easily as one could grow wheat; but the great difficulty all the way through was not only the climate and every operation connected with the growth of the grape, but the most important thing of all was the manipulation of the grape after it had been matured. In both Australia and California the difficulty had been that the grape had not been treated in a proper manner. In going over the Californian wines at Chicago, he found them something the same as the Australian wines in the Colonial Exhibition; the great mistake was to call them after the European types, because, when compared, they did not at all correspond with the port or sherry, or chablis or sauternes, after which they were named. They might be similar in colour, but in flavour and bouquet they were different altogether. This was the case with most of the Californian wines which he tasted. Some of them were really very nice wines, especially the sauternes, and came near the French type. The viticulturist in California had to face the difficulty of the great cost of labour, which was much higher than in France, and the consequence was that both the picking and pressing was done by machinery. Now, in France, Spain, and Portugal, nearly everyone agreed that that was not the best way of pressing the grape so as to get the best flavour out of it. In pressing by machinery there was a tendency to crack the stone, and then you got a large quantity of tannic acid into the wine, which made it very objectionable. The whole industry required a little more knowledge of chemistry, the same as prevailed in France. You wanted to learn not only the quantity of alcohol produced during fermentation, but the quantity of extractive matter left in the wine. When wine first began to be made in Australia, a large quantity of extractive matter was left in it, which, in a short time, made the wine turn sour. It was the same with some of the Californian wines, and these were, in consequence, very unstable. He believed Mr. Oldham would agree with him that if they did not begin with those wines, *de novo*, from the very grape onwards, they could not be quite certain, even with the "Big Tree" brand, that they would keep for any length of time. Again, there was another important matter for consideration. The French wine manufacturer of Bordeaux was a man who excelled in

his business, and the experience of hundreds of years had made him almost perfect in the manipulation of wine. As soon as fermentation had commenced, in a short time the wine was racked, re-racked, and racked again, until it was quite clear and fine. When it got to that condition it would keep well, and would not develop any objectionable qualities; but the misfortune in both Australia and California was that there was nearly always a lot of rubbish and mess left in the wine, which in the course of time decomposed and caused a disagreeable flavour; and when this wine was put on the market it naturally led to disappointment. He felt quite sure that the gentlemen connected with the wine industry in California were in a position to do the best they could to get the wine in the best condition for both the American and European markets, but they had a great deal to learn. In the first place the soil was too rich, and at first they planted their vines in unsuitable positions, and the wine produced was very rich, and developed in such a peculiar way that it was not at all like the type it was supposed to represent. They were improving now, and had come to the conclusion that the proper place for growing grapes for wine was pretty well up in the mountains, whilst in the valleys they might produce raisins, of which a very large quantity of very good quality were now being grown. Unfortunately the cost of labour made the wines rather expensive. He had examined a great number of wines produced by Mr. Oldham, and no doubt some of them were very good; in themselves they had everything necessary for the development of a good wine, but Mr. Oldham had given a great deal of care and attention to the matter, and he was glad to see that the industry was prospering in his hands, but he believed that he would agree with him that a great deal had yet to be done before they could compete with French wines. This year they had to compete with the grand vintage in France of 1893, which was the largest for twenty-five years. The value of clarets was now exceedingly good, and consequently the Californian wines could not compete with them so well as before. With regard to brandy, there was a large quantity of good young French brandy in the market, and he believed it would be as good and as cheap as ever. The French had now got over the ravages of the phylloxera, and this year he had seen some very good brandy indeed of 1893, and also of 1892, and he had no doubt that, in a few years, both the claret and brandy would be good and cheap. There was no doubt that wine was a very suitable thing to be grown in California; the authorities were doing all they could to favour the production of a large and good supply for the American market, and no doubt when there were more gentlemen like Mr. Oldham engaged in it, more of the best quality would be imported into England, and it would be appreciated as it deserved.

Mr. R. MANUEL said although he was now a professional man, the first twenty years of his life were

spent in connection with the wholesale wine and spirit trade, so that he took a special interest in the paper. What particularly struck him was the description of the varieties of grape, and the varieties and types of wine they produced; but he should like to know whether those wines were fortified to any extent for the foreign market, and, if so, whether they were fortified with brandy derived from grapes similar to those from which the wines themselves were made. Some 14 or 15 years ago, when he was connected with the trade, a great many European countries used to fortify their wines, not with brandy, but very largely with German potato spirit. He was not sufficient chemist to know whether that was injurious to the consumer, but it was certainly a kind of adulteration which was not desirable. Of course, he accepted Mr. Bannister's statements as absolutely accurate with regard to the brandy now coming forward, but about 1878 and 1879, when the vineyards of France were almost destroyed by the phylloxera, he knew that the two leading firms in Charente ceased to ship brandy entirely, except in cases; they could not keep up the standard they had been accustomed to in any quantities, and preferred to stop the supply, which was very honourable, but all firms were not so scrupulous. Mr. Bannister said they were very good chemists, and they proved themselves so at that time in the production of brandy. To his knowledge potato spirit was shipped from Hamburgh into the Charente district, transferred into brandy casks, coloured a little, and then came to London with the cachet of the Charente brand, and was accepted here as genuine French brandy. It might assist Mr. Oldham and those who wished to introduce Californian wines here, if they insisted on their being entirely free from suspicion in this respect.

Mr. W. G. TREWBY asked if it were the fact that two crops of grapes a year were produced in the irrigation districts of California?

The CHAIRMAN said he should like to enforce what Mr. Manuel had said with regard to the sophistication of wines, because, with all due regard to chemistry, he believed Mr. Bannister would agree with him that it was a grave question whether chemists could really say very much about wine in its finished condition. He believed that chemistry was really required in the process of manufacture, but it was quite another matter to report on the quality of wines from chemical examination. He had for many years regarded the question from a different standpoint; and having examined many specimens of alcoholic liquors, the result of his experience and experiments was that a good palate, and the condition of your head in the morning, were about the only tests for good wine. Of course, as a chemist, he ought not to suggest that a chemist could not analyse wine; he could, in a certain sense.

He could tell you how much extractive there was, how much sugar, how much alcohol, and so on; but when you had all that, you had not got all the particular value of the wine as a dietetic. Mr. Oldham, and all wine merchants, knew that wine, drunk in the natural way at a meal, and the spirit produced from that wine and mixed with water afterwards, so as to bring it to the same strength as claret or burgundy, produced physiological and dietetic results wholly different. The fact was, notwithstanding all that had been said with regard to the danger—if not the sin—of drinking alcoholic liquids, that good wines were food; and it seemed to him to be to the interest of the community that they should be well prepared, and that no artificially prepared compound should be added to the natural juice of the grape.

Mr. OLDHAM, in reply, said there was certainly one point in which California was at present deficient. There were very few wine merchants in California who thoroughly understood the keeping and maturing of wine as it is practised by the great Bordeaux merchants, where men were trained from infancy almost in the care and maturing of wines, and, consequently, were very skilful in these matters. In California, they were able to make excellent wine every year, but, unfortunately, a considerable quantity was not skilfully taken care of and matured. For the first year the farmer was able to take care of it, and it was then very good, but afterwards a great quantity got spoiled, and that was why they so often heard of wines which were sent here and elsewhere being inferior. Many of them were excellent when young and were well made, but they were afterwards neglected. For this reason he took all his wines direct from the farmers young, and took care of them from first to last. There was no temptation in California to adulterate, for the grape was the cheapest thing which could be used. The point about fortification was easily explained. The natural dry wines were almost invariably about 11½° alcoholic strength, and consequently it was not necessary to fortify them, either for shipment or keeping; they had strength enough to keep themselves, and, as far as he knew, nothing of the sort was done with regard to any of the dry wine shipped to this country. Until lately a tax had to be paid on brandy or spirit put into wines, which would make it more expensive than using the pure wine. Still, it was possible that some wine sent to New Orleans might be fortified, or have all sorts of things done to it. It was very hot there, and it was the custom to drink wine from the cask, which was very difficult in a hot place. With regard to the two crops, he had very little knowledge on the subject of the irrigation of vines, and he did not know of any attempt in California to make wine from grapes that were irrigated. There was a large amount of raisins grown in the valleys on irrigated land, but the best grapes for wine-making were not grown in the valleys at all; they were invariably

grown on the hill sides. There was a certain amount of truth in the statement about two crops in the case of the Zinfandel grape; it did bear two crops, to a certain extent, and the picture on the table showed the second crop growing. When they ripened, they were picked and made into wine, which he did not think was quite as good as that made from the first crop; but it was a sound ordinary wine, and the Zinfandel was not pretended to make a fine wine at the best.

The CHAIRMAN then proposed a cordial vote of thanks to Mr. Oldham for his interesting paper, which was carried unanimously.

Samples of the various types of California wine—"Big Tree" brand—were afterwards shown and tasted by the members.

Miscellaneous.

PRODUCTION OF COFFEE IN COSTA RICA

The coffee plant was introduced into Costa Rica in 1796, and its cultivation there has been continuous since that time. The production, which has been gradually and constantly increasing under the Spanish occupation, and since the independence of the country, amounted to 5,000 tons in 1861, and 18,000 in 1884. In 1891, the exports of coffee amounted in value to nearly 6,150,000 dollars. Costa Rica coffee is of superior quality, and commands the highest prices in the market. The Bureau of the South American Republics has recently issued a report, from which it appears that in 1890 the census of Costa Rica showed the existence of 8,130 coffee plantations, with 26,558,251 trees. These plantations were situated at various altitudes, from 2,500 to 5,000 feet above sea level, but the best results are obtained at 4,000 feet. The method of raising the young plants in nurseries, the distance at which they are planted, the preparation of the virgin lands for the plantations, and the subsequent cultivation of the trees, are the same as in the other coffee districts of the Western Continent. The seed beds are sown in May, and in the same month of the following year are set in the plantations. At the end of two years a few berries will be produced, the first regular crop being harvested the following season. The cultivation of other crops between the rows, while the trees are young, is practised to some extent, as elsewhere; the banana, or a quick-growing tree called *poro blanco*, being used to shade the young plants. The average annual cost per acre of working a coffee plantation after it comes into bearing is estimated at about six dollars, and the annual yield is put at an average of 2,500 pounds per acre. The gathering of the berry, which lasts from December

to March, is done by women and children, who pick the berries and place them in baskets, holding from eighteen to twenty quarts. The gatherers are paid about sixpence per basket, and active workers can fill eight to ten baskets per day. The provinces of San José, Alajuela, Cartago, and Heredia are those in which the cultivation of coffee is most extensively carried on; and in all these, except Cartago, the greater part of the available lands are already occupied by plantations. A vast extent of excellent coffee lands is found on the Atlantic side of the country between Cartago and Reventazon, and are said to be even better than those of Heredia and San José. The Costa Rican Government encourages the settlement of foreigners in the country, to engage in agricultural pursuits, and offers lands at very low prices, considering the great productiveness of the soil. Public lands may be acquired by pre-emption, in tracts of not less than 120 acres, by merely fencing them, and giving notice to the authorities of the intention of the occupant to put them under cultivation. If the cultivation be carried on for two years, a patent of ownership will be issued to the holder, and he may enclose, and claim in the same manner, another 120 acres, and so on. Lands may also be purchased, in areas not to exceed 1,500 acres for each person, at public auction, at prices varying from 3s. 4d. to 8s. per acre, according to locality, quality, irrigation, and nature of growth on them. If the lands at these prices are situated more than fifteen miles from a town of 3,000 inhabitants, or from a railroad, these prices will be reduced one-half; if from thirty to sixty miles, they will be sold at one-fourth; and if more than sixty miles, at one-eighth of the prices named. These lands may be paid for in cash, or in ten annual instalments at 6 per cent. interest. If at any time the purchaser shows that the improvements he has made are worth double the interest due, he is excused from payment of such interest; and if the improvements be worth twice as much as the price to be paid by the terms of the sale, he is exempted from payment of all interest due.

THE ORIENTAL PERFUME INDUSTRY.

The *Revue d'Orient* says that formerly the East alone supplied the whole of Europe with perfumes. Oriental perfumes are most frequently employed in their natural state, and a distinction is made between simple perfumes such as ambergris, musk, &c., and made-up perfumes which are composed of a mixture into which simple perfumes largely enter. Space would not permit of an enumeration of all the perfumes known in the East, as they amount to considerably over two hundred. One of the Turkish perfumes which is most successful is the odoriferous pastille; this small cone-shaped pastille, when lighted, diffuses a very agreeable perfume. Into its composition aloe wood and santal wood largely enter. The whole is pulverised, and made into a paste, then

solidified with the aid of resin. The secret of the manipulation of this pastille is jealously guarded, and the same may be said of many of the better-known perfumes prepared in the East. Essence of roses is too well known to require much description, this being one of the most important articles of Turkish perfumery. Essence of roses arrives at Constantinople in a round metal bottle; it is then in a perfectly pure state, but the merchants of Stamboul place it on the market in a very different condition, that is to say, they reduce it by the aid of the *intréchéyá*, a plant of the geranium species, whose leaves are highly scented. The glass bottles in which essence of roses is placed on the market, after manipulation by the Stamboul merchants, are obtained from Germany. In the East, as in Europe, patchouli is used chiefly for the handkerchief, and *gullouk*, a pomade into the composition of which essence of roses enters, is inserted into a small ivory egg-shaped receptacle, and carried on the person. The *Revue d'Orient* calls attention to a fashion among the Orientals which is full of originality. This consists in carrying fans, which are made of santal wood, and it is only necessary to slightly moisten this fan for it to emit a most pleasant and agreeable perfume. There grows in Turkey a plant which is called, in Turkish, *karagulluc*, meaning a black rose tree. With this plant a perfume is obtained which has the peculiarity of emitting a very unpleasant odour when in large quantities, and a very agreeable one when in small quantities. Oil obtained from aloe wood is largely used for the hair. As regards dyes and cosmetics used in the toilette of the Eastern women, the following is a description of some of the principal articles. The *rastic* is a paste, more or less liquid, and rather sticky. The ingredients used in its composition are kept secret, but it is said to contain a certain quantity of green vitriol. This paste is used to dye the hair black, light, or chestnut. At Constantinople a considerable number of women dye their hair an auburn colour, by the aid of this composition known as *rastic*. When it is sold it is placed with *quina quina*, a kind of yellow earthy powder, which preserves the freshness of the *rastic*. *Quina quina*, when diluted with water, is used for dyeing the nails of the hands and feet the colour of red ochre. *Sourmak*, which is a somewhat adhesive powder, is used for imparting a softness and brilliancy to the eyelashes. This powder is a species of coloured pounce, and is sold in small packets wrapped in cloth; it is afterwards placed for use in copper vases, of a purely Oriental form, called *Sourmeleck*. The cork is furnished with a stem, which penetrates the powder contained in the vase, and which is used in the same way as a pencil to trace a line on the eyelashes. *Calem issiz* is a Turkish pomade or cosmetic used for the moustache. In the same way as the *karagulluc*, this article diffuses a very unpleasant odour when in large quantities, but a pleasant one in small quantities. *Kalep-kiri* is a description of saponaceous

dust which is largely used in the Turkish bath. *Miskia*, a paste with a basis of chalk, is used for curing baldness, and for this purpose a composition of rams' horns reduced to powder and mixed with olive oil is also used.

Notes on Books.

REPORT ON TECHNICAL INSTRUCTION IN LANCASHIRE. By J. A. Bennion, M.A. Preston: C. W. Whitehead, 1893.

When the Customs and Excise Act of 1890 placed at the disposal of the County Councils the money which had been raised by the spirit duty, which Parliament refused to apply to the purpose for which it had been raised, namely, the compensation of holders of licenses, a sum of £40,000 a year was placed at the disposal of the Lancashire County Council. A committee was appointed to deal with the question of applying the fund to technical instruction; and they, as was the case in other counties, received a large number of applications for grants out of the fund. Eventually, the Council appointed Mr. Benion as their Director of Technical Instruction, and his first duty was to produce the report which forms the subject of this notice. It is a quarto, of nearly 600 pages, and contains a vast amount of information in regard to the educational institutions—technical and other—in Lancashire. The county is divided into county boroughs, non-county boroughs, local board districts, and rural districts. The county boroughs are, of course, outside the administrative area of the county, and over them the Lancashire County Council exercises no jurisdiction. The report itself consists of a general account of the steps which have been taken in promoting technical education in Lancashire; but the principal information is contained in the appendixes. The first appendix gives a full and detailed account of the work done in each borough or district under the Council, together with full information as to the educational facilities of each. This is followed by nine other appendixes dealing with various portions of the subject, and with eleven tables of statistics dealing with the area, number of classes, students, subjects taught, remuneration of teachers, &c. The information appears to be of a very complete character, and the work will doubtless be very useful to the authorities of other parts of England who have to deal with the difficult problem of technical education, especially in rural districts.

General Notes.

PETROLEUM FIELDS OF INDIA.—In the discussion on Mr. Oldham's paper (see *ante*, p. 156), col. 2, lines 22 and 31, read *Assam for Burma*; lines 23 and 32, read *Brahmaputra for Irawadi*.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

FEBRUARY 7.—“Automatic Balance of Reciprocating Machinery, and the Prevention of Vibration.” By W. WORBY BEAUMONT. SIR FREDERICK BRAMWELL, Bart., D.C.L., F.R.S., Deputy-Chairman of the Council, will preside.

FEBRUARY 14.—“The St. Pancras Electric Light Installation.” By HENRY ROBINSON, M.Inst.C.E.

FEBRUARY 21.—“Electric Signalling without Wires.” By WM. HENRY PREECE, C.B., F.R.S. SIR RICHARD WEBSTER, G.C.M.G., Q.C., M.P., Chairman of the Council, will preside.

FEBRUARY 28.—“Rainfall Records in the British Isles.” By G. J. SYMONS, F.R.S. SIR FREDERICK BRAMWELL will preside.

MARCH 7.—“Refrigerating Apparatus.” By PROF. CARL LINDE.

INDIAN SECTION.

The meetings of February 15, March 8, April 26, and May 24, will be held at the Society of Arts; those of February 8, and March 19, at the Imperial Institute.

THURSDAY, FEBRUARY 8, at 4.30 p.m.—“Telegraphic Communication between England and India: its Present Condition and Future Development.” By E. O. WALKER, C.I.E., M.I.E.E., formerly of the Government of India Telegraph Department. SIR THOMAS SUTHERLAND, K.C.M.G., M.P., will preside.

THURSDAY, FEBRUARY 15, at 4.30 p.m.—“Experiences at the Court of Afghanistan.” By JOHN A. GRAY, late Surgeon to His Highness Abdul Rahman Khan, Ameer of Afghanistan. The HON. GEORGE N. CURZON, M.P., will preside.

THURSDAY, MARCH 8, at 4.30 p.m.—“The Indian Currency.” By J. BARR ROBERTSON.

MONDAY, MARCH 19, at 8.30 p.m.—“Indian Railway Extension: its Relation to the Trade of India and of the United Kingdom.” By JOSEPH WALTON. SIR JAMES KITSON, Bart., M.P., will preside.

THURSDAY, APRIL 26, at 4.30 p.m.—“Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh.” By SIR AUCLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieutenant-Governor of the North-West Provinces and Oudh.

THURSDAY, MAY 24, at 4.30.—“Chota Nagpore: its Mineral Wealth and its value to India.” By J. F. HEWITT, late Bengal Civil Service. SIR ALEXANDER WILSON, formerly President of the Bengal Chamber of Commerce, will preside.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on Tuesdays, at Eight o'clock:—

FEBRUARY 20.—“Belgian Industry and the Antwerp Exhibition, 1894.” By EDOUARD SEVE. SIR ALBERT K. ROLLIT, LL.D., M.P., Vice-President of the Society, will preside.

MARCH 6.—“Travels on the Zambesi.” By Mons. FOA.

APRIL 17.—“Tasmania and the forthcoming Hobart International Exhibition, 1894-95.” By J. F. ECHLIN.

MAY 1.—“Paraguay.” By A. F. BAILLIE.

MAY 29.—“Education in Victoria.” By Prof. C. H. PEARSON, M.A., LL.D.

APPLIED ART SECTION.

Tuesday Evenings, at Eight o'clock :—

FEBRUARY 13.—“Modern Development of Illustrated Journalism.” By HORACE TOWNSEND.

FEBRUARY 27.—“Goldsmiths' Work: Past and Present.” By Mrs. PHILIP NEWMAN.

APRIL 10.—“The Evolution of Decorative Art.” By HENRY BALFOUR, M.A.

MAY 8.—“Pewter.” By J. STARKIE GARDNER.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock :—

PROFESSOR FRANK CLOWES, D.Sc., “The Detection and Measurement of Inflammable Gas and Vapour in the Air.” Four Lectures.

LECTURE III.—FEB. 5.—Employment of a large alcohol flame in a special lamp—Recent modifications—Application of a standard hydrogen flame in an ordinary illuminating safety-lamp—Attempts to use a small alcohol flame in an ordinary safety-lamp.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 5 ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. Frank Clowes, “The Detection and Measurement of Inflammable Gas and Vapour in the Air.” (Lecture III.)

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, Town-hall, Westminster, S.W., 7½ p.m. Inaugural Address by the President, Mr. G. A. Goodwin.

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Dr. A. Dupré, “Note on an Interesting Explosion caused by Sodium Peroxide.” 2. Mr. P. W. Dreaper, “Theory of Dyeing.” (Part I. Ingrain Colours.)

Imperial Institute, South Kensington, 8½ p.m. Mr. J. E. Muddock, “Our New Highway to the Orient, across the Mountains, Prairies, and Rivers of Canada.”

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. H. Blackburn, “London Streets and Buildings Bill, 1894.”

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. Lecture by the Rev. H. N. Hutchinson.

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. Lewis F. Day, “Art About Us.”

TUESDAY, FEB. 6 ... Royal Institution, Albemarle-street, W., 3 p.m., Prof. Charles Stewart, “Locomotion and Fixation, in Plants and Animals.” (Lecture IV.)

Central Chamber of Agriculture (at the House of THE SOCIETY OF ARTS), 11 a.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Boverton Redwood, “The Transport of Petroleum in Bulk.”

Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Mr. H. Law, “Principles of Calculating Areas, Cubic Space, &c. Interpretations to Plans and Sections to Scale.”

Pathological, 20, Hanover-square, W., 8½ p.m.

Biblical Archaeology, 37, Great Russell-street, W.C., 8 p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1.

Prof. Howes, “Synostosis and Curvature of the Spine in Fishes.” 2. Mr. F. E. Beddard, “Some Points in the Development of the Tadpole of *Xenopus*.” 3. Mr. Charles W. Andrews, “Some Remains of *Æpyornis* in the British Museum.”

Inventors' Institute, 27, Chancery-lane, W.C., 8 p.m.

WEDNESDAY, FEB. 7 ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. W. Worby Beaumont, “Automatic Balance of Reciprocating Machinery, and Prevention of Vibration.”

Geological, Burlington-house, W., 8 p.m.

Entomological, 11, Chandos-street, W., 7 p.m. 1.

Dr. F. A. Dixey, “The Phylogeny of the Pierinæ, as illustrated by their Wing-markings and Geographical Distribution.” 2. Dr. T. A. Chapman, “The Life-History of *Eriocephala calthella*, and observations on *Limacodes*.” 3. Mr. Robert H. F. Rippon, “Description of a variety of *Ornithoptera* (*Priamoptera*) *urvilliana*.” 4. Mr. Hamilton H. Druce, “Description of the female of *Hypochrysois scintillans*, Butl.”

Archæological Association, 32, Sackville-street, W., 8 p.m.

Obstetrical, 20, Hanover-square, W., 8 p.m. Annual Meeting.

THURSDAY, FEB. 8 ... SOCIETY OF ARTS, John-street, Adelphi, W.C. 4½ p.m. (Indian Section.) Mr. E. O. Walker, “Telegraphic Communication between England and India: its Present Condition and Future Development.” (This Meeting will be held at the Imperial Institute, S.W.)

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m.

Mr. J. J. Harris Teale, “The Life-History of a Mountain Range.”

Royal Institution, Albemarle-street, W., 3 p.m.

Mr. W. Martin Conway, “The Past and Future of Mountain Exploration.” (Lecture I.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Major-General C. E. Webber, “Some Notes on the Electric Lighting of the City of London.”

Mathematical, 22, Albemarle-street, W., 8 p.m.

FRIDAY, FEB. 9 ... Royal Institution, Albemarle-street, W., 8 p.m.

Weekly Meeting, 9 p.m. Prof. W. F.

R. Weldon, “Fortuitous Variation in Animals.”

United Service Inst., Whitehall-yard, W., 3 p.m.

Sanitary Institute, 74A, Margaret-street, W., 8 p.m.

Mr. J. Wallace Peggs, “Water Supply, Drinking Water, Pollution of Water.”

Astronomical, Burlington-house, 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Science Schools, South Kensington, S.W., 5 p.m. 1. Annual General Meeting. 2. Mr.

O. G. Jones, “The Viscosity of Liquids.”

SATURDAY, FEB. 10 ... Botanic, Inner-circle, Regent's-park, N.W., 3¼ p.m.

Royal Institution, Albemarle-street, W., 3 p.m.

Lord Rayleigh, “Light: with special reference to the Optical Discoveries of Newton.” (Lecture I.)

Journal of the Society of Arts.

No. 2,151. VOL. XLII.

FRIDAY, FEBRUARY 9, 1894.

All communications for the Society should be addressed to
the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS.

The Examinations of the Society of Arts in Commercial subjects, Theory of Music, and Domestic Economy will be held this year at the various centres on the evenings of the 12th, 13th, 14th, and 15th March.

The Practical Examinations in Vocal and Instrumental Music will be conducted by Sir Joseph Barnby and Mr. W. G. McNaught, A.R.A.M., at the House of the Society of Arts, and will commence on Monday, the 11th June.

Particulars can be obtained on application to the Secretary.

Candidates for the Society of Arts examinations in Musical Theory are recommended by the examiners (Sir Joseph Barnby and Mr. W. G. McNaught) to use the interval nomenclature shown in the following Table:—

INTERVAL NOMENCLATURE RECOMMENDED.

Read from below upwards.

Perfect Octave	..	C	D	E	F	G	A	B
Major 7th	..	..	B		E			
Minor 7th	..	..		C	D		F	G
Major 6th	..	..	A	B		D	E	
Minor 6th	..	..			C		F	G
Perfect 5th	..	..	G	A	B	C	D	E
(1) Augmented 4th or Tritone	..							
(2) Diminished 5th								
Perfect 4th	..	..	E		A	B		
Major 3rd	..	..		F	G		C	D
Minor 3rd	..	..	D	E		G	A	B
Major 2nd	..	..			F			C
Minor 2nd	..	..	C	D	E	F	G	A

All intervals smaller than minor or perfect to be called *diminished*. All intervals larger than major or minor to be called *augmented*.

CANTOR LECTURES.

On Monday evening, 5th inst., Professor FRANK CLOWES, D.Sc., delivered the third lecture of his course on the "Detection and Measurement of Inflammable Gas and Vapour in the Air."

The lectures will be printed in the *Journal* during the summer recess.

Proceedings of the Society.

TENTH ORDINARY MEETING.

Wednesday, February 7, 1894; SIR FREDK. BRAMWELL, Bart., D.C.L., F.R.S., Deputy-Chairman of the Council, in the chair.

The following candidate was proposed for election as a member of the Society:—

Bruff, Charles Clarke, Coalport, Shropshire.

The following candidates were balloted for and duly elected members of the Society:—

Bennion, J. A., County-offices, Preston, Lancashire.

Clémence, Auguste, 34, Ely-place, E.C.

Fisher, S. Melton, Arts Club, Hanover-square, W.

Gritton, Joseph, 97, Highbury-quadrant, N.

North, John William, A.R.A., Beggearnhuish-house, Washford, Taunton.

Sander, Henry F. C., The Camp, St. Alban's.

The paper read was—

THE AUTOMATIC BALANCE OF RECIPROCATING MACHINERY AND THE PREVENTION OF VIBRATION.

By W. WORBY BEAUMONT, M.Inst.C.E.

Vibration, set up by machinery of various kinds, has often given rise to problems of great difficulty, and the cause of the vibration has sometimes been as obscure as the phases of variation in its transmission have been mysterious. The character of the vibration differs with different classes of machinery, and with the same machinery working at different speeds. It is intended in this paper to deal with a limited class of machines, and to refer more particularly to those in which the essential parts reciprocate or gyrate at a high speed or not at a low speed. It is, moreover, intended to deal chiefly with machines in which the reciprocating or gyrating part receives motion from a source, and is not the source of rotation, as in steam-engines, although brief reference will be made to vibration set up

by the latter, and to its possible prevention. The tendency of any unsymmetric mass to rotate about its centre of gravity, and to rotate the axle or shaft upon which it is running round that centre, when it is not coincident with it, may be prevented, by additions to the mass which move the centre of gravity of the whole to the centre of rotation. This simplest case, however, is frequently complicated in practice by the impossibility of placing the rotating parts in the same plane. Generally, the difficulties in connection with these cases are much less than those in which a motion of reciprocation or of gyration is imparted by means of a rotating part.

In almost all cases, motion of one or other of these kinds in the machinery now to be considered is effected by a crank-shaft and connecting-rod, or an equivalent of these; and, except where the crank has three or more dips connected by rods, which move reciprocating parts simultaneously in opposite directions, the perfect balance of such a crank and connected mechanism is very difficult and almost impossible.

In some cases, the use of a heavy fly-wheel, with only as much unsymmetric weight as will balance the crank and the connected reciprocating parts, will approximate to this result; but the weight of wheel necessary to secure the smooth running of machines in which the main parts are reciprocated at high speed has numerous practical disadvantages, which generally precludes its use. It is common to balance, as it is called, the crank and connecting-rod by excentric weights, which frequently are very much heavier and, at the speed of their rotation, have momentum much greater than the parts supposed to be balanced. This is in consequence of the necessity for opposing the inertia of motion, not only of the crank and connecting-rod, but of the heavy reciprocating part operated by the crank, and alternately its inertia of rest. This necessarily throws large stresses upon the crank-shaft and its bearings, which form the abutment against which the pull and push of the crank acts and re-acts. These bearings have to be—in all cases—fixed to the framing of the machine, part of which is to be reciprocated or gyrated, or to something which relatively to that part is at rest. The action and reaction resulting from the working of the machine is therefore, except in so far as it is balanced in one direction, transmitted to the framing of the machine, or the building foundation, or floor to which the bearings

are attached. By the use of heavy excentric weights on the crank shaft in the way mentioned, the effect of the push and pull on the connecting rod may, in the direction of motion of the thing reciprocated, be eliminated, but in the direction normal to this, a nearly equal action and re-action is experienced by the bearings in consequence of the influence of the rotating excentric weight. This may be shown by reference to the diagram, Fig. 1, in which A represents the part to be reciprocated; B, the crank-shaft; C, the connecting-rod; and D D, excentric weights, in the

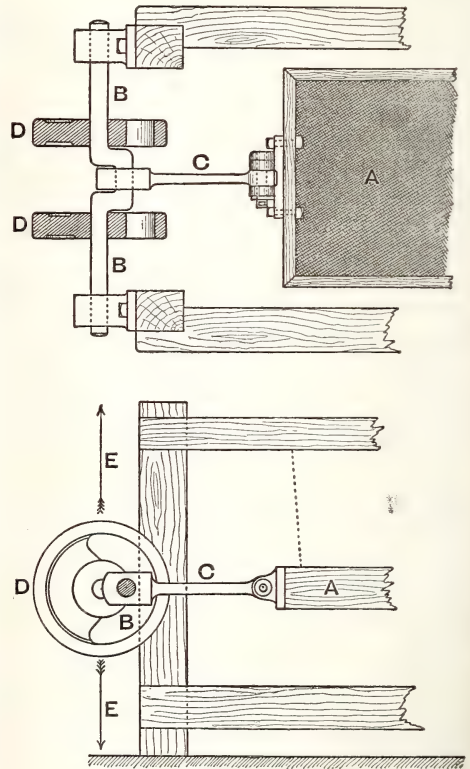
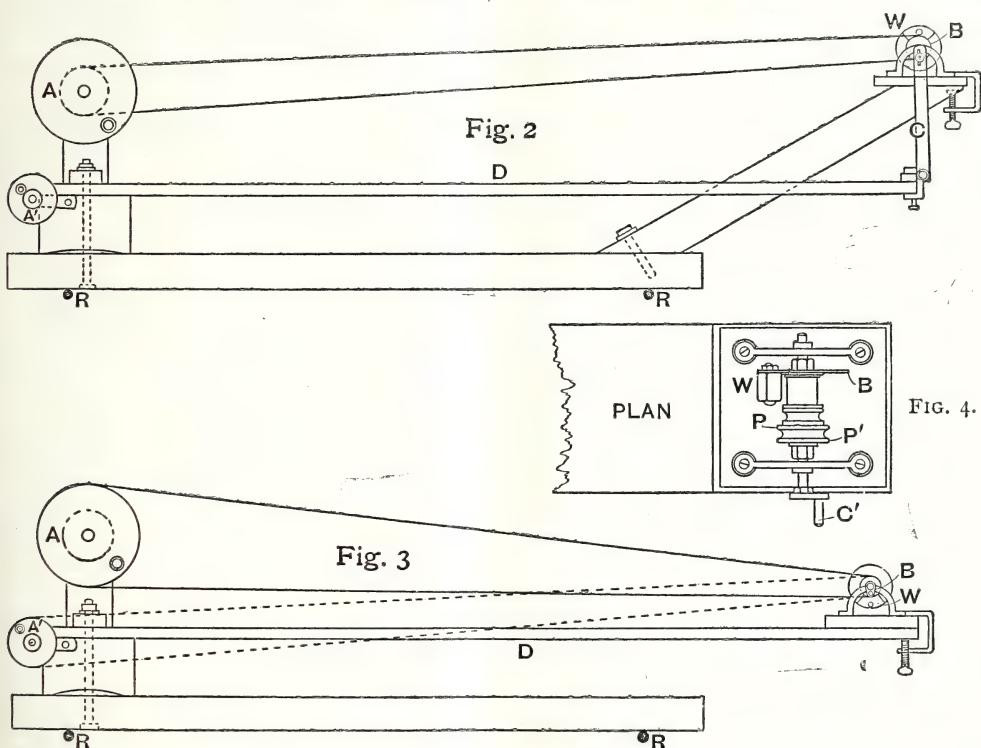


FIG. 1.

form of discs, heavy on one side. In the direction of the length of the part A, which may be a sieve of the several kinds used in flour-mills, or a screen for crushed minerals, the inertia and momentum are equal, and are approximately balanced by those of the excentric rotating weight, D, but in the vertical direction, as indicated by the arrows, E E, the work done by the weights, D, in balancing forces in a horizontal direction is also done in the vertical directions, E E, by these weights, or, more correctly speaking, the vertical upward and downward force exer-

cised by these weights is nearly as great as the horizontal backwards and forwards force exercised by them in balancing the movement of the reciprocating part. This force, the vertical action of the rotating excentric weights, sets up vibration in the floor or foundation on which the machinery stands, and, generally speaking, the action of the weights is not confined to a vertical direction, but departs therefrom sufficiently to set up racking stresses in the frame of the machine. The whole of the work done in this way is lost work, and some idea of how much that loss may be can be shown by the working of the model marked A. Fig 2.

In this model, vertical motion of small range is imparted by a crank and connecting-rod, C; the weight of the crank and connecting-rod being balanced by an excentric weight, W, on a disc, B, on the crank-shaft. So long as the piece, D, to which motion is communicated is thus operated, the excentric weight acts as a balance weight; but it will be seen from the indicators on the model, which, for the purposes of explanation, magnify the range of vibration set up, that the effect of the push and pull on the arm, D, of the machine represented by the model is very considerable. In this respect it represents the condition of working



of a good many machines—vibration—which is only prevented by excessive strength and excessive weight. Some idea of the effect in the vertical direction of the balance weights, D, used in the machine represented by Fig. 1, may now be conveyed by allowing the corresponding balance weight, W, in the model, Fig. 2, free scope, by placing the crank-shaft and its bearings on the part D of the machine represented by the model, to which reciprocating movement has to be communicated as shown also in Fig. 3. The connecting-rod is dispensed with, and the framing of the machine is relieved of the bearings, so that any work in the vertical direction, or force exerted by the

balance weight, will now be expended on the part to be moved, and only on that. The balance weight is now unbalanced by that of the connecting-rod and its connections, and by rotating the crank-shaft it will be seen that the essential part of the machine now receives vertical movement, just as it did before the connecting-rod was removed. This is the effect when the speed of rotation is greater than the elastic period of the part D of the machine moved. If, now, the speed of rotation be altered, so that it may coincide with the elastic period of the part D to which the shaft is attached, it will be seen that this same little, out-of-balance weight will set up

motion of a very large range. Thus, may be afforded some idea of the harmful vibrations which may be set up in the floors and walls of buildings containing machinery, in which forces, otherwise unbalanced, are originated. It must be noted that the force which gives rise to the vertical movement in the machine shown by the model is equally active in tending to produce motion in the direction of the length of the reciprocated part, and it is only opposed by the weight and fixity of the frame of the machine. The force is, however, available for setting up motion or vibration in the horizontal direction of that to which the machine is attached.

Very many machines, such as that represented in diagram, Fig. 1, may be made to perform their work by a gyratory, instead of a reciprocating motion, and such machines in considerable numbers and of several kinds are used for the sorting and sizing of grain, crushed ores, and in flour-mills. A simple form of such a machine was represented by a diagram on the black board, in which, as before, A represents a sieve; B a crank-shaft; C a crank disc carrying a crank-pin, by which motion is given to the sieve. The disc, C, is heavily weighted on the side opposite the crank-pin, so that the disturbing forces, set up by the gyrating sieve, may be, to some extent, balanced and thereby eliminated. The reaction, however, of the force exerted by the crank-pin is equally and oppositely experienced by the bearing B, with the result that the framing of the machine within which the sieve A is suspended, must be made of great strength, and it is commonly necessary, even with this strength, to prevent the rocking of the frame by connecting it by struts or ties to the building in which it is fixed. Now the whole of the work expended in setting up vibration of the frame of the machine or the building containing it, is not only waste work but it is a very harmful waste.

It is one of the chief objects of this paper to show that by far the larger proportion of all the machines, in which vibration is set up by reciprocating parts, may be so constructed, that the waste referred to may not only be prevented, but may be converted into useful work, employed in the operation of the essential parts of the machine. It will be shown that this may be done in such a way that the parts operated shall experience much less severe stresses than in any of the arrangements commonly used,

The method of working now to be shown

includes a new mechanical motion, involving something of the nature of a mechanical paradox; but it secures a perfectly automatic balance in itself and in the thing it operates. Instead of attempting to make an accurate balance, according to methods hitherto adopted, the author proceeds in an exactly contrary direction, and purposely puts that which gives rise to the motion out of balance.

The causes of vibration—which has hitherto been a source of the greatest trouble to mechanical engineers—is thus converted into a useful servant, and in many cases that which has been a harmful mechanical by-product, is utilised, and made to do the whole of the work, of which it is an offshoot. In brief, the cause of vibration is converted into a vibromotor.

In the model marked B, is a part corresponding to that marked A in the diagram, Fig. 1, operated by means of a crank shaft and weighted disc. To the frame is attached an indicator, which makes visible the vibration set up in it by the wasted reactions. By removing the crank-shaft from the framing, and leaving the latter only the work of supporting the sieve, and then operating the sieve by the means which now have to be described, it will be seen that the frame is relieved of those stresses, and, therefore, of the vibratory effects, while the work of operating the sieve is materially lessened. To the sieve is attached the bearing for a small spindle which carries an excentric weight, W, Figs. 5, 6, 8, 9, equivalent to that of the weighted part, C, of the crank disc, in other words to carry an unbalanced excentric weight. This small spindle is rotated by a flexible or jointed connection, C, which is free to move with the movements of the sieve. Now, as will be seen from the working of the model, B, the rotation of this excentric, unbalanced weight sets up movement by its reaction at every part of its rotary path, but it is now running in a bearing, which is attached not to the framing of the machine or any fixed part, but only to that which has to be moved, namely, the sieve, A, hence every action and reaction now set up respectively by the rotating excentric weight and the sieve is expended entirely in the operation of the latter. This being the case, there is now no vibration set up in the framing of the machine, as is shown by the quietude of the indicator, which before was violently agitated. Other models, C, D, are shown, which further illustrate this, motion

being conveyed, in one case, to a reciprocating part by a driving spindle which runs in a bearing attached to a freely suspended frame. Another model, similar to that shown in Figs. 5, 6, 7, 8, 9, is also exhibited in order to show how a gyrating screen may be operated by

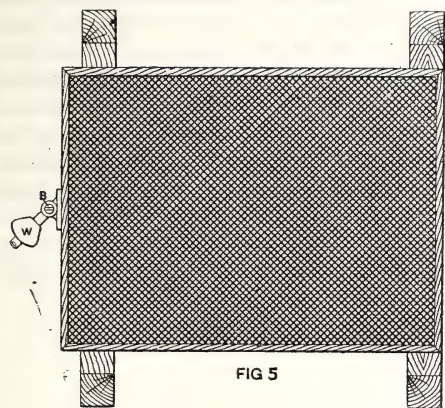


FIG 5

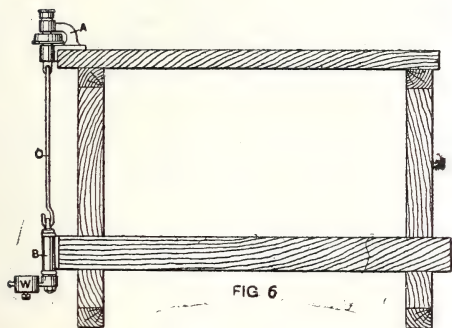


FIG 6

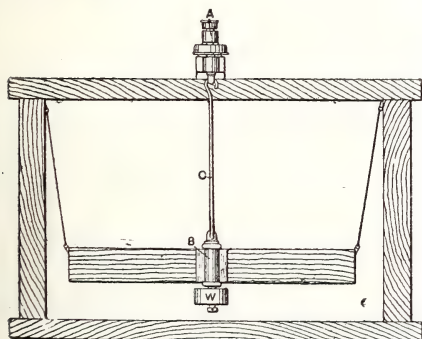


FIG 7

means which automatically balance all the disturbing forces.

It is common with most classes of machinery by which buildings are set in vibration to oppose the movement, which the disturbing force tends to set up, by the inertia of very heavy foundations; but there is the objection

In many cases where the whole of the disturbing force cannot thus be utilised, the absence of perfect balance may be rendered harmless by permitting motion through small range in that which experiences first the effect of that want of balance; and, in general, it may be

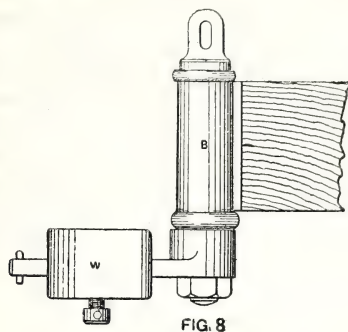


FIG 8

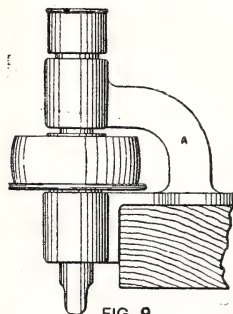


FIG 9

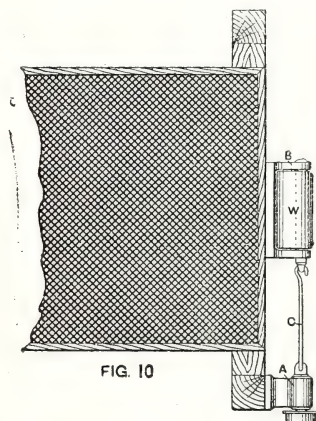


FIG 10

said that undesired vibration is the result of opposing a force which can either be avoided, to this that the wear of the bearings of the machinery is greater than it would be if it were possible to obtain perfect balance of the moving parts. The system is, moreover, sometimes not successful, even very heavy

foundation work failing to prevent the vibration of buildings. The models and diagrams herein referred to show that, in many cases, this may be obtained, and it will have been seen that this is done by permitting the main parts of the machine to move through a range which is precisely in proportion to the disturbing force and the thing which it disturbs. by proper balancing of machinery, or prevented by permitting a small range of movement in that machinery instead of endeavouring to hold it absolutely motionless. It is a matter of common knowledge that engine-drivers and engineers on many of the old steamboats were in the habit of allowing their holding down bolts, and sometimes others, to be loose purposely, because by this the shaking of the

boat was observed to be less, though the reason given was that the engine ran more smoothly.

In balancing steam-engines the difficulties connected with the balance of reciprocating parts by rotating excentric weights are complicated by the fact that different rotating unsymmetric parts lie in different planes, but it has been shown by Mr. Yarrow, amongst others, that considerable relief may be obtained by excentric weights opposite the cranks, after the manner of those shown in Fig. 1, but although the effect of the reciprocation of the piston and connecting-rod may be thus eliminated, the excentric weights set up vibration in a direction transverse to the line of reciprocation. Mr. Yarrow has also gained good

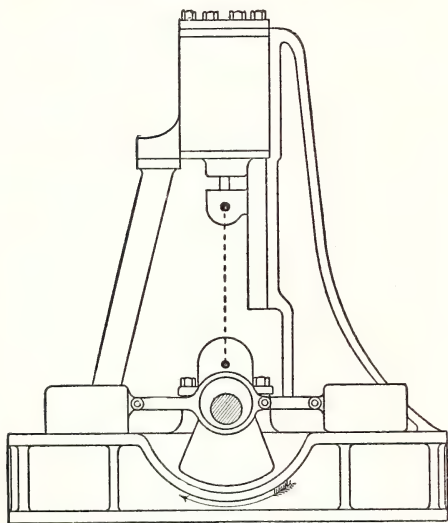


FIG. 11

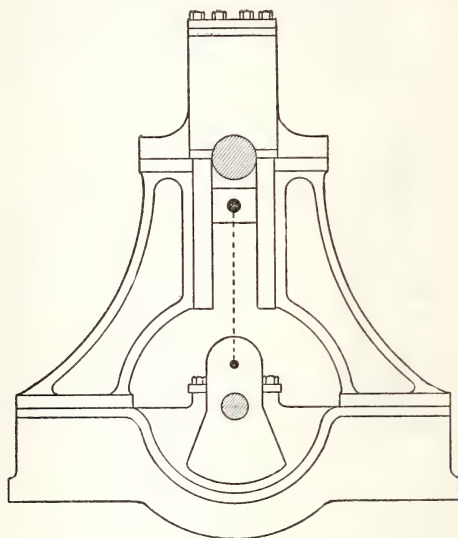


FIG. 12.

results with small engines, by opposing the vertical motion that would otherwise occur, by the inertia of what he has termed bob weights. These have, however, the disadvantage that they have to be operated by excentrics which are not frictionless. Such weights, however, might be used, working horizontally in conjunction with the balance weights on the crank, but so operated that their inertia would be opposed to the horizontal movement, which is set up by the excentric weights on the crank shaft. In some cases engines of the marine form instead of being fixed to a bed-plate on the bottom framing might be suspended near the bottom of the cylinders, by framing which would permit motion through a small range, and when we consider how small that move-

ment need be it is not improbable that by connecting the crank-shaft with the screw propeller shaft by couplings such as those used in the French navy, the vibration might be entirely avoided. This may be explained, by reference to diagram (Figs. 11 and 12), which represent a vertical engine, with the crank, connecting rod, and piston balanced, as against vibrating motion in a vertical direction. The same motion is not, however, balanced, or, rather, prevented, in the horizontal direction, but may, in such cases, be aggravated by the excess of the weight, D, over that necessary to balance the crank, the piston, and about half the connecting-rod. In many cases, it would introduce practical difficulties in connection with

the steam pipes, if the engine were allowed to move horizontally, as suggested; but when this is the case, the engine may be fixed, and a weight or weights, *W*, be moved by an excentric in a horizontal direction. This would neutralise the vibratory tendency; the weights would not be very large, and may be easily predetermined. The diagram, Fig. 12, shows the engine carried by a large trunnion shaft. Assume that the engine represented by Fig. 11 weighs, say, two tons, and that is balanced as to vertical forces by the weight *D*, and that this same weight is, say, 200 lbs. greater than is required for the balance of the forces set up by the parts moving horizontally; then the horizontal movement of the engine, which might be set up by this excess weight, would have a range of half an inch. But if we make the excess weight move something as indicated by the sliding or suspended weights, *W*, shown on Fig. 11, then the vibrating tendency may be practically eliminated by using two weights of 400 lbs., having a stroke of 3 in. On the other hand, if the engine be suspended as in Fig. 12, and the weight on which the effect of the excentric weight of 200 lbs. can be expended be one ton, then the swing opposite the crank will be one inch.

Model *E* is intended to illustrate the fact that piers of bridges which, during construction, have been loaded with weights considerably greater than those they are intended to carry, have been known to settle afterwards,

under the influence of vibration caused by passing trams. The model, *E*, represents a small weighted pier, standing in a box of granular material, into which it does not sink, although loaded. Upon setting up vibration of very small range, by means of a vibromotor on a horizontal axis, the pier immediately and rapidly sinks into the material.

As further illustrations of some points in connection with the vibration of buildings, a model is exhibited which shows how vibration, set up by machinery in one part of a building, may give rise to vibration of very different intensity and degree in different floors of that building, and how evidence afforded by two sets of observers may be contradictory and yet both perfectly true. Model *F* shows a number of super-posed blocks intended to represent a small section of a structure such as a wall. When that, upon which this stands, is caused to vibrate, different parts of this column have very different ranges of movement.

Figs. 13 and 14, and model *G*, are illustrative of the usual method of balancing a rotating



FIG. 13.

thing, such as the armature of a dynamo or the drum of a thrashing machine. Fig. 13 may be taken as representing either of these resting on a pair of level knife-edges which are commonly used for balancing purposes.

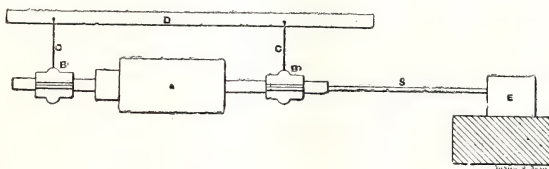


FIG. 14.

When a drum is out of balance it will rest on these knife-edges when the heaviest part, or the part most excentric, is downward. To balance the drum, counterpoise weights are attached somewhere on a diameter opposite this heaviest part until the drum is indifferent and will rest wherever it is placed on the knife-edges. This it will do even if the balance is effected by adding balancing weights at either *A* or *A'*, Fig. 13, and for a stationary thing this would be sufficient; but it is misleading for high-speed machinery. It has been pointed out by Mr. G. Kapp, with reference to apparatus he uses for balancing dynamo armatures, that the

added counterpoise must be in the same plane as the excess weight, which throws the armature out of balance, or each weight will act separately in setting up vibration by causing the structure of which it forms a part to endeavour to revolve round the centre of gravity of the whole, which is not either at *A* or *A'* coincident with that of the shaft. With a view to the detection of the site of the excentric weight throwing the whole out of balance, it is necessary to rotate it at a considerable speed, and in such a way that it is free to vibrate as it chooses. This can be done as shown in Fig. 14, wherein the armature, *A*, is placed in

bearings, B¹ and B², carried by suspenders, C and C¹, the armature spindle being rotated by a flexible spindle, S, driven by a pulley at E. The bearings, B¹ and B², being free to swing, the amplitude of their movement will, either of them, depend upon the departure of the mass centre of the spindle, and it can be seen whether the counterpoise is required at one or both ends.

The same thing may be found by suspending the armature spindle vertically from a vertical rotating spindle by means of a shackle and hooked rod. This is shown by the model, G, and the whirling apparatus to which it is attached. The same apparatus affords the means of showing, by means of a spindle and excentric weight as used in the vibromotor, and shown in Figs. 5 to 9, how various may be the vibrations set up by a spindle rotating an unbalanced mass at different or varying speeds.

The fact that the wall model F moves is a proof that there is something connected with it that wants to move and we will not let it, or wants to move more than we will let it. Now this is bad policy, and the lesson to be learned from it is that, as we cannot stop the unbalanced thing from moving, we had better make our calculations afresh on the assumption that that fact must not be ignored, and that it must be allowed to move. It is no use trying to stop it, unless we give it something to expend its energy upon. We must let it move because we cannot help it, but we can help letting it move without taking toll. It is one of those "forces in nature which we must direct for the use and convenience of man," and in a general way it may be said, that when a piece of mechanism wants to wobble, it is obviously either wrongly constructed, or if it is not and wants to wobble, then let it wobble, but make it wobble something you want wobbled. In most cases it will not wobble so much and never so forcibly if we don't try to stop its wobbling.

DISCUSSION.

The CHAIRMAN said this paper was a most valuable one. He did not know whether he should be justified in calling wobbling a waste product, but if it were, Mr. Beaumont was another instance of a gentleman who by careful study had discovered how it might be utilised. The lesson, which a child could appreciate, seemed to be that whatever any one wanted to do it was better to let him do. This invention gave a mode of working reciprocating machinery, which was be-

coming more and more necessary for milling and other purposes, and, secondly, it led to a consideration of the question of balancing machinery, which gave a great deal of trouble to engineers, and on both points the paper afforded valuable information.

Mr. J. I. THORNYCROFT, F.R.S., said this paper threw a great deal of light on what had been called wobbling, and the illustrations showed very clearly that where there was a disturbing force it was very important to allow it to work in a useful rather than a harmful way; and in the case of sieves this principle seemed to have been very satisfactorily applied. Mr. Parsons had given an illustration of how to treat a shaft, allowing it to move slightly, when you could not keep it from moving. He used very high speeds in driving machinery, so high that the stiffness of the shaft was insufficient to resist the accelerating force, which tended to bend it if the two ends were firmly held. He, therefore, let the two ends move in their bearings, employing a device in which a number of discs were held somewhat loosely in the bearings, and thus perhaps anticipated to some extent the idea now put forward. This object was, to use a machine in which the full velocity of a discharge of steam could be utilised, and in that line he had done some useful work. He did not think the model illustrating the effects of vibration on a wall fully represented the case, because the indicators were said to all have the same period of vibration, and therefore he could not see how, from a given disturbing force, one could act differently from another. In a building there were structural differences and different loads on the floors, so that they had different periods of vibration, and that was the difficulty with regard to ships. Different parts vibrated differently, and whereas at one speed a disturbance would be found in one part of the ship, at another speed you would find a disturbance in another part. It was very difficult to obtain a perfect balance, or to give the engine liberty to move; if not impossible, this suggestion was certainly a novelty. You would have to adjust the speed of the engine, so as to avoid coinciding with the period of vibration of the whole mass, and then so arrange the details, which would probably vibrate at a much higher rate, that they also should not coincide with the vibrations of the engine.

Prof. GREENHILL, F.R.S., said the last illustration was very interesting in its bearing on the design of locomotive engines. In America crank-axes were unknown, and some twenty years ago it was predicted that they would disappear from English locomotives also; but this had not proved to be the case; and for high-speed engines, inside cylinders, involving the use of a crank-axle, seemed more and more coming into favour, probably, because it brought the moving parts closer together, and secured greater steadiness. The principle now

enunciated was, to a certain extent, applied in the milk-separating machine, where the upper bearing of the spindle was left free, being merely constrained by an india-rubber ring, so that the revolving mechanism tended to steady itself, and spin in a vertical position, like a top.

Sir DOUGLAS GALTON K.C.B., F.R.S., said it would be a great advantage if the vibrations of locomotives could be checked by some application of this principle. The great evil of all trains was the want of balance in the moving parts of the locomotive; and they were all much indebted to Mr. Beaumont for the very lucid way in which he had brought forward this new view of vibration.

Mr. PIERSON TURNER said he had applied this principle very successfully to the sieves in flour-mills, which were now large and heavy, and the greatest difficulty was experienced in preventing their working from shaking the walls of the mill. By means of a balance weight, however, as Mr. Beaumont had described, this vibratory motion had been turned to a useful purpose, and they could run the machines faster, and do more work. He did not know that the vibromotor was so applicable to steam-engines; but the whole paper was very instructive.

Mr. E. C. DE SEGUNDO asked if any experiments had been made showing that an engine balanced in the way suggested would have the same mechanical efficiency as one whose motion was completely restrained, as Professor Kennedy intimated it should be. An engine hung on trunnions would not be a completely restrained machine, and if it were placed in a ship, it appeared to him that, owing to the shock of the waves and other disturbing influences, the vibrations might get out of phase, and possibly a worse state of things might be brought about than now existed. He did not see any mechanical impossibility in such an arrangement, as oscillating engines had their steam supplied through the trunnions; but the cylinder and piston, &c., could not be rigidly connected to that part of the framework which held the bearings, and that would appear to be a serious inconvenience. Vibration in buildings was a most important matter, and few who had anything to do with disputes arising out of the communication of vibration from machinery to adjoining buildings, would not welcome any safe guide on the subject. In a recent case in which he was engaged, he found a vast amount of vibration, greater on the third floor than the second, and least of all on the ground floor, although the nature of the building would have led one to expect it to be most marked there. It was of a curious character, and seemed to be made up of a number of smaller vibrations having positive and negative values; at any rate, he could distinctly recognise points of maximum and minimum effect, the number of which per minute could be readily counted. He found exactly the same effect in the engine-room, from

which the vibration was alleged to proceed, and therefore felt justified in concluding that the vibration noticed in the adjoining house arose from the machinery. However, when the case came on for trial, it was adjourned that the jury might have a view of the premises; and, strange to say, when they all went to judge of the amount of vibration, it was not apparent. He went into the engine-room, and ascertained that the usual work, and, in fact, rather more, was being done, so that it was very difficult to understand, and, in fact, all attempts to explain it to the jury failed, and the case was lost. Mr. Beaumont's experiments seemed to show that at certain speeds some parts of a structure might be affected, and not others, and that might be the explanation in the case he had cited; or, possibly, some of the vibrations corrected or annihilated the others at certain speeds, whilst at other speeds they would never get quite into the opposite phase, but produced the maximum and minimum effects he had noticed.

Colonel CUNNINGHAM said, as a mere mathematical question, the balancing of any rotating drum on an axle could never be accomplished by simply obtaining statical equilibrium; there must be complete dynamical equilibrium, and any part removed any distance from the axis must be balanced by a part in a similar dynamical position. For permanent comfortable motion to go on, the axis must not be merely the principal axis of motion, but the axis of least inertia. That, of course, was very difficult to attain, but if not attained, there must be wobbling, which only could be met either by humouring, or by rigid framework, which latter must necessarily be somewhat distressed by the shaking. Mr. Beaumont seemed to have shown that where the principal reciprocating parts were entirely in one direction, it was easy to obtain complete balance by an excentric weight, but that weight introduced a greater want of balance in the direction at right angles to the principal direction. He had discovered how to meet that to a great extent, partly by allowing a certain amount of motion to take place, and partly by introducing certain balance weights; and this seemed to be his most important discovery. He had dealt chiefly with the slight oscillating motion of sieves and seemingly mostly with the view of easing their frames and the walls of the buildings in which they were used; but there was a more important matter, and that was the far more violent oscillation of rapidly-moving machinery, such as in locomotives and marine engines. As kept on tending to greater weights and higher speeds in such engines, and to higher speeds in dynamos, this question became more and more important, and merits much study.

Mr. A. P. TROTTER said one problem which Mr. Beaumont had attacked in a manner quite new to him, was that of sieve motion. This had given enormous trouble, and was of great commercial im-

portance, but it appeared now to be absolutely solved. The steam-engine problem was another, and on that also a good deal of light had been thrown. The side movement was well understood in machine building, and hitherto there had been two courses open to meet it. One was the old-fashioned method of putting in a heavy foundation, and relying on mass, but now-a-days people did not like to go to so much expense for concrete underneath the floor; the other method was to put indiarubber, or felt, or some elastic material underneath, and in some cases that had proved an aggravation of the evil it was intended to cure. If an engine were put upon an elastic foundation, allowing a movement of 1-16th of an inch, or less, and balance weights were suspended by chains, on tie-rods from the ceiling, possibly coupled with twin engines, this most important problem might be solved. It was rather late in the day to bring forward the question of balancing armatures, but so long as they were balanced on knife-edges, it was worth while to show by experiment what the real effect was.

Mr. BEAUMONT, in reply, said Mr. Parsons' mode of getting over the wandering which would take place with a rotating spindle, when all upon it was not in perfect balance, was very ingenious; and he did not know that any great improvement could be made upon it; still, there was the fact that some of the parts of his bearings were continuously in motion, and it had been suggested that a bearing should be made somewhat in the same way, and the shaft allowed to run, until it had taken up the position it wanted; and then the parts of the bearing should be fixed, so that the somewhat complex structure ran afterwards as a solid bearing, with the spindle within it running as part of the whole rotating mass. In the case of a wall, it was quite true that at different parts there were different ranges and intensities of vibration; but the period would, for any one region, remain the same throughout the wall, until you came to a part at which a node existed, and from this point to one of maximum vibration, there might be one vibration opposed to, and, in some cases, annihilating another. But that would not be found in the simple case shown in the model, though it might be found, by taking a longer and more rigid column, or a thin wall, which, with respect to any two parts at a distance apart from each other, less than any assignable distance, might be assumed to be perfectly rigid and elastic. Some very important experiments had recently been made which bore on the question referred to by Professor Greenhill, and showed the enormous hammering effect of the weight put into the driving wheels of locomotives to balance the crank, which was largely in excess of that required for balancing the vertical movements. So much so, that the whole weight on the driving wheels of something like 18 tons, or 9 tons per wheel, was not only considerably relieved, but the wheel was actually lifted off the rail. Of

course, this must do considerable damage at high speeds. With reference to Mr. Turner's remarks, he might say that he had recently seen in a mill, fitted with machinery by Messrs. E. R. and F. Turner, sieves weighing about 112 lbs., which were moved by a rod in torsion, in the same way as in the model he had shown, of only $\frac{3}{8}$ in. in diameter. Of course, if the work were at all considerable, as ordinarily measured, the speed being about 400 revolutions a minute, such a wire would be twisted off directly. In reality, any of these things worked in this way became a big pendulum, and the power required to move it was very small. He did not see that the power of the engine would be in any way effected by what he suggested. Although suspended, it was a perfectly rigid structure within itself, and the piston would have exactly the same effect on the crank as if it were fixed. Mr. Segundo's remarks had confirmed what he said about the wall, and Colonel Cunningham had correctly interpreted what he said about the frame of machinery. No doubt much stronger frames were used than was necessary, which meant more work than was necessary. In several cases, sieves worked by means of the automatically balancing vibromoter, had been put up without any frames at all—simply hung from the ceiling. The bearing on the sieve might be attached at the corner or in any convenient place, and the spindle which drove it might be put anywhere. The question was as important with regard to marine engines as anything, perhaps more so, but he must say he thought the main difficulties might be overcome without much difficulty though not without some expense. Mr. Trotter's remarks with regard to solid foundations were quite correct. He had known cases in London where great expense had been incurred to prevent an engine, moving with very little practical result. The only correct principle was to give the disturbing force something useful to do, or, if that was not possible, to let it move harmlessly.

The CHAIRMAN then proposed a vote of thanks to Mr. Beaumont, which was carried unanimously, and the meeting adjourned.

General Notes.

CHICAGO STATISTICS.—It appears from the official statement of the City Comptroller of Chicago that the assessed valuation of the city, as equalised for 1893, is \$245,790,351.00; the total bonded debt of city of Chicago, \$18,515,450.00; less water debt (works owned by city), \$4,894,000.00; less sinking fund, \$333,366.79; making a net city debt of \$13,288,083.21.

RABBIT SKINS.—Melbourne is the largest market for rabbit skins in Victoria, and also the port of shipment. The exports, in 1891, were 5,800,810 for the United Kingdom, 427,900 for France, 67,010

for New South Wales, 34,990 for the United States, and 7,500 for Belgium. In 1892, 145,000 were exported to France. The finer kinds of rabbit skins are sold at from 8d. to 11d. per lb., and others at from 4d. to 6d.

IMPORTS OF HAY.—During the twelve months ended 31st December, 1893, 263,050 tons of hay were imported into the United Kingdom, an amount to be compared with the imports of the year 1892, which only reached 61,237 tons. The largest items in this total of the imports in 1893 were 26,839 tons from North Russia, 28,332 tons from Holland, 63,175 tons from Canada, 101,132 tons from the United States, and 24,594 tons from the Argentine Republic.

TECHNICAL INSTRUCTION.—The deputation appointed by the Lancashire County Council to visit silk, horological, and mining schools of France, Germany, and Switzerland, which consisted of Mr. Thomas Snape, M.P., Mr. W. Lees McClure, and Mr. J. A. Bennion, have reported to the Council the results of their visit. The commission visited horological schools at Paris, Besançon, Cluses (Haute Savoie), Geneva, Bienne, Neuchatel, Le Locle, Chaux de Fonds, and Fürtwangen; four silk technical schools at Lyons, one at Crefeld, and one at Zurich; and mining schools at Paris, St. Etienne, Donai, Auzin, Bochum, and Duisburg.

ECONOMIC VALUE OF LEAVES AS FORAGE.—The nutritive value, as forage, of the leaves of trees, and the economical advantage of thus utilising them during a hay famine like the present, have already been referred to in the *Journal*; and M. Cormouls-Houlès has found that the leaves and young shoots of oak brush yielded a better return than if the wood were used as fuel. Whereas, formerly, the land only returned 26 francs per hectare ($2\frac{1}{2}$ acres), he obtained last year the sum of 127 francs with the leaves for forage. The hectare yielded 8 tons of shoots and leaves, equal in nutritive value to 5·3 tons of hay, which is worth the 127 francs, or £5 1s. 7d., above named.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

FEBRUARY 14.—“The St. Pancras Electric Light Installation.” By HENRY ROBINSON, M.Inst.C.E. W. H. PREECE, C.B., F.R.S., will preside.

FEBRUARY 21.—“Electric Signalling without Wires.” By WM. HENRY PREECE, C.B., F.R.S. SIR RICHARD WEBSTER, G.C.M.G., Q.C., M.P., Chairman of the Council, will preside.

FEBRUARY 28.—“Rainfall Records in the British Isles.” By G. J. SYMONS, F.R.S. SIR FREDERICK BRAMWELL, Bart., D.C.L., F.R.S., will preside.

MARCH 7.—“Refrigerating Apparatus.” By PROF. CARL LINDE.

Papers for which dates have not yet been fixed:—

“Reproduction of Colour by Photography.” By CAPTAIN W. DE W. ABNEY, C.B., F.R.S.

“London Coal Gas and its Enrichment.” By PROF. VIVIAN LEWES.

“Experiments in Aeronautics.” By HIRAM S. MAXIM.

“Automatic Gem and Gold Separator.” By WILLIAM S. LOCKHART.

“Application of Electricity to the Disinfection of Sewage.” By MONS. HERMITE.

“Design Applied to Carpets.” By ALEXANDER MILLAR.”

INDIAN SECTION.

The meetings of February 15, March 8, April 26, and May 24, will be held at the Society of Arts; the meeting on March 19 will be held at the Imperial Institute.

THURSDAY, FEBRUARY 15, at 4.30 p.m.—“Experiences at the Court of Afghanistan.” By JOHN A. GRAY, late Surgeon to His Highness Abdul Rahman Khan, Ameer of Afghanistan. The HON. GEORGE N. CURZON, M.P., will preside.

THURSDAY, MARCH 8, at 4.30 p.m.—“The Indian Currency.” By J. BARR ROBERTSON.

MONDAY, MARCH 19, at 8.30 p.m.—“Indian Railway Extension: its Relation to the Trade of India and of the United Kingdom.” By JOSEPH WALTON. SIR JAMES KITSON, Bart., M.P., will preside.

THURSDAY, APRIL 26, at 4.30 p.m.—“Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh.” By SIR AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieutenant-Governor of the North-West Provinces and Oudh.

THURSDAY, MAY 24, at 4.30.—“Chota Nagpore its Mineral Wealth and its value to India.” By J. F. HEWITT, late Bengal Civil Service. SIR ALEXANDER WILSON, formerly President of the Bengal Chamber of Commerce, will preside.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on Tuesdays, at Eight o'clock:—

FEBRUARY 20.—“Belgian Industry and the Antwerp Exhibition, 1894.” By EDOUARD SÈVE. SIR ALBERT K. ROLLIT, LL.D., M.P., Vice-President of the Society, will preside.

MARCH 6.—“Travels on the Zambesi.” By MONS. FOA.

APRIL 17.—“Tasmania and the forthcoming Hobart International Exhibition, 1894-95.” By J. F. ECHLIN.

MAY 1.—“Paraguay.” By A. F. BAILLIE.

MAY 29.—“Education in Victoria.” By Prof. C. H. PEARSON, M.A., LL.D.

APPLIED ART SECTION.

Tuesday Evenings, at Eight o'clock :—

FEBRUARY 13.—“Modern Development of Illustrated Journalism.” By HORACE TOWNSEND.

FEBRUARY 27.—“Goldsmiths' Work: Past and Present.” By Mrs. PHILIP NEWMAN.

APRIL 10.—“The Evolution of Decorative Art.” By HENRY BALFOUR, M.A.

MAY 8.—“Pewter.” By J. STARKIE GARDNER.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock :—

PROFESSOR FRANK CLOWES, D.Sc., “The Detection and Measurement of Inflammable Gas and Vapour in the Air.” Four Lectures.

LECTURE IV.—FEB. 12.—Application of the standard hydrogen flame to the detection and measurement of petroleum vapour in tanks and other spaces—The test-chamber apparatus for observing and measuring the indications of the above testing apparatus.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 12... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Frank Clowes, “The Detection and Measurement of Inflammable Gas and Vapour in the Air.” (Lecture IV.)

Camera Club, Charing-cross-road, W.C., 8 p.m. Mr. Alfred Watkins, “Bees and Bee-keeping.”

Scottish Society of Arts, 117, George-street, Edinburgh, 8 p.m. 1. Report by Committee on Mr. Wright's paper on a “Brush Borer's Guide.” 2. Mr. James A. Millar, “A Gasalier Water-Feeder.” 3. Mr. George Beilby, “The MacArthur-Forrest Process of Extracting Gold from its Ores.”

Imperial Institute, South Kensington, 8½ p.m. Mr. Henry Blackburn, “Morocco and Algeria from an Artist's Point of View.”

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mr. Harry Lake, “Johore.” British Architects, 9, Conduit-street, W., 8 p.m. Papers on “Mosaics and Fresco.”

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m.

Mr. George Kennan, “Russian Political Exiles.”

TUESDAY, FEB. 13... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. Horace Townsend, “Modern Development of Illustrated Journalism.”

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Charles Stewart, “Locomotion and Fixation in Plants and Animals.”

Camera Club, Charing-cross-road, W.C., 8 p.m. Mr. Redmond Barrett, “Retouching.”

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. Boverton Redwood's paper, “The Transport of Petroleum in Bulk.” 2. Reception by the President and Council.

Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Mr. Keith D. Young, “Sanitary Building Construction.”

Photographic, 50, Great Russell-street, W.C., 8 p.m. Annual Meeting.

Anthropological, 3, Hanover-square, W., 8½ p.m.

1. Mr. Sidney H. Ray, “The Languages of British

New Guinea.” 2. The Right Rev. Dr. Bompas (Bishop of Selkirk), “The Indians of the Mackenzie and Yukon Rivers.” 3. Surgeon-Major L. A. Waddell, “The Thibetan House Demons. Some Ancient Indian Charms from the Thibetans.” 4. Exhibition of Various Objects from the Malay Peninsula, by Mr. Cecil Wray.

Colonial Inst., Whitehall Rooms, Whitehall-place, S.W., 8 p.m. General Sir George Chesney, “The British Empire.”

Asiatic, 22, Albemarle-street, W., 3 p.m.

WEDNESDAY, FEB. 14... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Prof. Henry Robinson, “The St. Pancras Electric Light Installation.”

Sanitary Institute, 74A, Margaret-street, W., 8 p.m.

Dr. F. J. Waldo, “The Sanitation of Places where Food is Stored and Prepared.”

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

THURSDAY, FEB. 15... SOCIETY OF ARTS, John-street, Adelphi, W.C. 4½ p.m. (Indian Section.) Mr. John A. Gray, “Experiences at the Court of Afghanistan.”

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Miss Pertz, “Hygroscopic Movements connected with Seed Dispersal.” 2. Mr. J. C. Willis, “Contributions to the Natural History of the Flower.” (Part II.)

Chemical, Burlington-house, W., 8 p.m. 1. Ballot for the Election of Fellows. 2. Dr. Bernard Dyer, “Determination of the Available Mineral Plant Food in Soil.” 3. Mr. C. T. Kingzett, “Aerial Oxidation of Turpentine and Essential Oils.”

London Institution, Finsbury-circus, E.C., 6 p.m. Dr. E. Klein, “Cholera.”

Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. C. Purdon Clarke, “Indian Art, as represented in the Indian Section of the South Kensington Museum.”

Royal Institution, Albemarle-street, W., 3 p.m. Mr. W. Martin Conway, “The Past and Future of Mountain Exploration.”

Historical, 20, Hanover-square, W., 8½ p.m. Annual Meeting.

Numismatic, 22, Albemarle-street, W., 7 p.m.

Imperial Inst., South Kensington, S.W., 4½ p.m.

Mr. W. A. Wills, “The Trade, Commerce, and Products of South Africa.”

Camera Club, Charing-cross-road, W.C., 8 p.m. Mr. E. J. Humphrey, “A Plea for Serious Work in Photography.”

FRIDAY, FEB. 16... Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Prof. Nichol, “Bacon's Key to Nature.”

United Service Inst., Whitehall-yard, W., 3 p.m. Major W. W. C. Verner, “Military Topography up to Date.”

Civil Engineers, 25, Great George-street, S.W., 7½ p.m. (Students' Meeting.) Mr. Walter Beer, “Ship Slipways, having special reference to the Dover Slipway.”

Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Prof. W. H. Corfield, “Sanitary Appliances.”

Queckett Microscopical Club, 20, Hanover-square, W.C., 8 p.m. Address by the President, Mr. E. M. Nelson.

SATURDAY, FEB. 17... Royal Institution, Albemarle-street, W., 3 p.m. Lord Rayleigh, “Light: with special reference to the Optical Discoveries of Newton.”

Journal of the Society of Arts.

No. 2,152. VOL. XLII.

FRIDAY, FEBRUARY 16, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

On Monday evening, 12th inst., Professor FRANK CLOWES, D.Sc., delivered the fourth, and concluding lecture of his course, on the "Detection and Measurement of Inflammable Gas and Vapour in the Air."

On the motion of the CHAIRMAN (Prof. Clement Le Neve Foster, F.R.S.), a vote of thanks was passed to the lecturer for his important course of lectures.

The lectures will be printed in the *Journal* during the summer recess.

Proceedings of the Society.

INDIAN SECTION.

Thursday, February 8, 1894; Sir THOMAS SUTHERLAND, K.C.M.G., M.P., in the chair. The paper read was—

TELEGRAPHIC COMMUNICATION BETWEEN ENGLAND AND INDIA: ITS PRESENT CONDITION AND FUTURE DEVELOPMENT.

By E. O. WALKER, M.I.E.E., C.I.E.

(Late of the Indian Telegraph Department.)

My plea for bringing this paper before you lies in the fact that I have spent many years in the telegraph service of India; that I have been witness of the gradual growth of its traffic, and of the careful building up of its telegraphic communications with other countries; that in dealing with telegrams in such important places as Bombay, Calcutta, and Madras, I have been brought into contact with the commercial publics which have the larger interests in foreign telegraphs, and to whom the cost, as well as the accuracy, rapidity,

and regularity of dispatch of messages are so important; and that I have been privileged to know, perhaps better than those outside the telegraph service of the State, what can and should be done to meet the wants of the public in these respects.

The time seems to have arrived when it may be useful to review what has been done in the past towards bringing India and the United Kingdom into closer community of interests by the telegraph, and to offer some suggestions which may lead to the telegraph becoming a more important factor in trade, by making its use cheap.

The early days of the electric telegraph take us back to 1836, when Gauss and Weber exhibited their apparatus at Göttingen; followed in 1837, by the successes of Cooke and Wheatstone in England, of Morse in America, and of Steinheil in Bavaria. The preliminary experiments of these workers proved that not only could electricity* be made to traverse a conducting wire suspended in the air, but that it would pass through it also when immersed in water, or buried in the earth, if the wire were protected by an insulating substance. Thus the possibility of opening up telegraphic communication across seas and channels became evident.

The first wire laid between Dover and Calais, in 1850, was coated thickly with gutta-percha, and sunk by means of leaden weights. This cable might have been working now had the core been mechanically protected, but, from its weakness, it was soon broken and useless. The second cable, protected by iron wires wound spirally round the gutta percha case, was laid in 1851, by the Submarine Telegraph Company, of which Sir James Carmichael and Mr. J. W. Brett were directors, and Messrs. Crompton and Wollaston engineers. This enterprise led the way for the gradual growth of a network of cables over the whole globe.

The telegraph was now making its influence felt among commercial communities. It was being found that it made trade brisk, by aiding a quick interchange of commodities; and profitable, by preventing the accumulation of large stocks through the early information it afforded of the state of the large markets; and rendered trade safe, by strengthening the control by Government of the foreign affairs of the State. It was beginning to be realised that the material welfare of a country would, there-

* "The Electric Telegraph," by Dr. Lardner, revised by E. B. Bright.

fore, be largely dependent in the future upon its connection by telegraph with the foreign territories with which it traded.

In 1854, Mr. Gisborne* put forward a project for a cable from the Dardanelles to Alexandria, as a first step towards establishing communication with India. A concession was obtained from the Porte, but the scheme fell through. At this time, although early in the history of submarine telegraphs, some were found to favour the cable route exclusively, while others placed their faith entirely in overhead wires, save in localities where frequent damage to such lines was to be apprehended. Events have proved that India has benefited by this difference of opinion, since it has secured to her two good working routes.

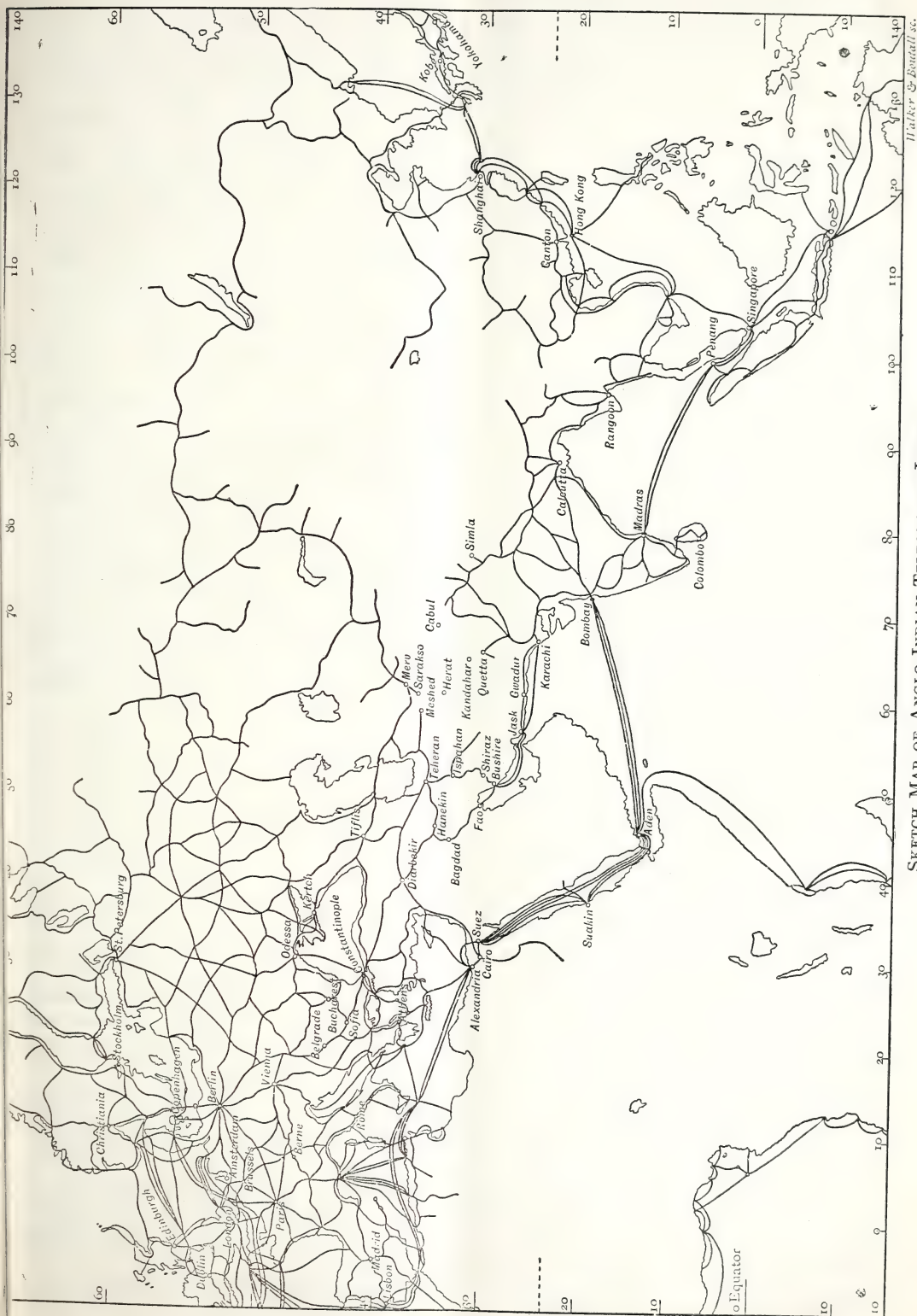
In 1855, advocates of the overland telegraph formed the European and Indian Junction Telegraph Company, to erect telegraphs from Alexandretta, on the coast of Palestine, to Korna, at the junction of the Euphrates and Tigris; but Turkey eventually refused the desired concession. Alexandretta would have been joined by cable to Brindisi or Marseilles.† The fact appears to have been that Turkey was contemplating the construction of a line through Asia Minor, from Scutari to Baghdad, and no doubt preferred to retain the control and the revenues in her own hands. Sir William O'Shaughnessy, the pioneer and chief of the telegraphs in India, had about this time suggested to the East India Company a direct line from Kurachi to Constantinople, *via* the Persian Gulf, and negotiations with the Porte resulted in an undertaking by that Government to construct the whole of the line that would fall within their Turkish territory, the British Government to appoint agents, directors, and artificers for the work. The East India Company would co-operate by laying cables in the Persian Gulf to meet the Turkish lines at Basra or Fao. These plans having taken shape aroused public attention, and in the year 1858 the comparative advantages and disadvantages of overland and submarine telegraphs were extensively discussed in the *Times* and the *Morning Chronicle*. Sir W. P. Andrew and Sir Henry Rawlinson advocated the Asiatic Turkey and Persian Gulf route. London was already in communication by wire with Constantinople, and material for the telegraphs had been sent by Turkey to the head of the

Gulf. But both these gentlemen welcomed the notion of two distinct lines to India as affording indispensable security of communication. At the same time, the line from Suez to Alexandria, a link in the proposed cable route, was regarded as unsafe in the event of a European war, and although the telegraph had reached Malta, by cable from Italy (1858), still there remained 800 miles of cable to be laid from thence to Alexandria, and 4,000 from Suez to Kurachi. Sir W. Andrew considered that the distance from Suez to Aden would be too great for transmission of signals by cable without repetition, and that to land on the Red Sea coast would be to incur dangers from troublesome Arabs and coral reefs. The line from Constantinople to Busra, 1,700 miles, would follow the common post road from Scutari to Diarbekir and Baghdad, and, according to Sir Henry Rawlinson, by organising patrols, and by making presents to the chiefs of the contiguous tribes, no mischief need be apprehended. He admits that, from Baghdad to Busra, the line would be more insecure, and he would have laid it for this portion in the River Tigris. Sir W. Andrew thought an overland line might be taken to Busra, and then the length of cable in the whole circuit from England to India would be something like 1,200 miles only, namely, in the Persian Gulf; while the Red Sea route would require 5,000 miles, much of which would be subject to damage by coral reefs. Sir Austen Layard, together with the Rev. G. Badger, who knew the country, considered there would be great difficulties between Diarbekir and Baghdad with the Bedouins, and worse between Baghdad and Busra; post-bags were at that time interfered with. Again, they thought that the landing-places in the Persian Gulf were likely to be attacked. These gentlemen believed the Red Sea route to be free from these liabilities. Major-General F. R. Chesney was of opinion that both routes were feasible, and that Great Britain required both lines to India. He said that the greater part of the route from Baghdad to Constantinople was as safe as an English road. Mr. Ainsworth, who had accompanied General Chesney in his survey of the valley of the Tigris, endorsed this statement.

It must be confessed that the fears as to the stability of our overland communication were, in some respects, verified, but, fortunately, did not at the time so far prevail as to frustrate the scheme. The revolt of the Arabs in the Delta led to a lengthy interruption of the

* "Telegraph and Travel," by Sir F. Goldsmid.

† "Notes on the Direct Telegraph," by Sir H. C. Rawlinson.



SKETCH MAP OF ANGLO-INDIAN TELEGRAPHY LINES.

Indo-Turkish lines; snowstorms, floods, and predatory tribes have in turn assailed them. It has been no uncommon thing for the lines between Fao and Constantinople to be interrupted for a total period of fourteen days in the year, and from the latter place to London for longer. Again, in Persia, in 1872, the starving populace destroyed parts of the line, stole the material, and murdered one of the telegraph inspectors. In the same year part of the Indo-European system in North Germany was overthrown by snowstorms. In 1877 the Persian lines were stopped for eleven days by wilful damage, and between Persia and England by other causes for 126 days. In 1882 a violent snowstorm destroyed 250 miles of line near Odessa, and communication was stopped for 25 days in consequence. In 1884 snowstorms again in Persia broke down the wires twice for a week at a time. On one occasion a local governor, who was about to lose his appointment, cut the wires in order to spite the Persian Government. All this would be far from encouraging to those who would rely upon overhead wires, did we not know that by firm control of the people through whose territories they pass, by incessant attention to the strengthening of the lines, and by the elimination of weak points, interruptions such as I have described have been rendered rare, and further that, owing to land lines being cheap, we can afford to have two or three alternative ones with plenty of wires, for the same cost as our submarine cable.

An influential section of the commercial community favoured a submarine telegraph to India, and in 1857 the Red Sea Telegraph Company was formed*, with a guarantee from Government, to lay a cable from Suez to Kurachi *via* Aden, in connection with a direct cable from Malta to Alexandria, projected by the Anglo-Mediterranean Telegraph Company. It was true that the sea route to India would require 5,000 miles of cable, but the supporters of the scheme thought that the cable once laid would be lasting, that the liability to interruption in war and times of political disturbance would be much less than by the overland route by Turkey or Persia. For an enemy to grapple and raise cables for the purpose of cutting them would require not only a knowledge of their exact positions, and a ship specially fitted, but, above all, would take up too much time. In 1859-60 Messrs. Newall laid the Red Sea

cable at a cost of £800,000. The bold scheme unfortunately, ended in total failure; the cable was never worked throughout, and Government became involved in heavy pecuniary obligations. The manufacture and laying of cables were not so well understood then as was the case a few years later. The cables* were not, as was subsequently found to be necessary, tested for insulation under water from the time of manufacture until paid out from the ship, and, in the present case, are said to have been laid too taut, so that they were suspended across the inequalities in the ocean bottom, instead of being slack enough, as they should be, to lie evenly with the irregular contour. Then, again, the route had not been, as is invariably done now, carefully surveyed, and the consequence† was that damage was done by the cable chafing on the coral reefs. Further, the Red Sea cable was covered externally with light wire guards only, unprotected by bituminous compound. These wires, which should give strength to the cable, rusted so quickly in the intensely salt water, that in a short time the cable could not be lifted for repairs. In the idea, probably, that signalling would be accelerated by so doing, the cable was divided into short sections, touching at Cassiri and Souakin in the Red Sea, and at Hellania and Muscat on the east coast of Arabia, the lengths of the various portions being as follows:—‡

	Miles.
Suez to Cassiri	255
Cassiri to Souakin	474
Souakin to Aden	627
Aden to Hillania	718
Hillania to Muscat	486
Muscat to Kurachi	481

The course thus taken lay through much shoal water, notoriously bad for a cable. The failure of this cable, and of the first Atlantic one, which worked for only one month, which involved a loss of £450,000, greatly discouraged further enterprise. Sir James Anderson thus summarises the causes which led, in the early days of submarine telegraphs, to the failure of cables; and it is worth while to recapitulate them, because they show how careful observation and investigation have led to the establishment of the reliable circuit of the present day, and the claims the latter now have to public confidence. Speaking thirteen years

* Paper read before the Statistical Society by Sir James Anderson, 1872.

† "The Telegraph to India," by Sir C. Bright.

‡ "Telegraphic Journal," 1872.

• "The Telegraph to India," by Sir C. Bright.

after the failure of the first Atlantic and Red Sea cables, he says it was due to (1) inexperience of insulating material; (2) impurity of the copper conductor, by which its resistance was increased; (3) the mechanical difficulty, in keeping the copper wire in the centre of the insulating medium, and its consequent tendency to protrude through the latter, or to be covered in places by a thin film of it only; (4) laying cables from sailing ships in tow of steamers, the former having insufficient steerage way and head winds, which involved too much slack cable, with a devious course, and with no ready means of stoppage when a fault occurred. He says that experience disproved also the notion that there was little motion in the sea at a depth of 100 fathoms. On the contrary, the Falmouth cable was moved, chafed, and destroyed at a depth of 500 fathoms; and the Channel Islands cable suffered in the same way. He mentions, likewise, the injuries caused to gutta-percha by the teredo borer even at a depth of 1,200 fathoms, an enemy which in more recent years has become well known, and to guard against which brass or copper tape is spirally wound round the core of cable. To return to the overland route, the line from Scutari to Baghdad had been begun in 1859, under the direction of Colonel Biddulph and Lieutenant Houldsworth, and was carried on to Baghdad by Messrs. Carthew and McCallum. In 1860, Colonel Kemball, Resident in Turkish Arabia, investigated the causes of the defective communication then existing by the new wire, and the Porte undertook to carry out his recommendations. There was some doubt as to whether a line could safely be carried from Baghdad to Basra, owing to the troublesome character of the tribes in that locality, and it was not until October, 1863, that Turkey agreed to complete the line so as to meet the Indian Government cable projected from Bushahr to Basra. Meantime, in 1861, to overcome this difficulty, the Shah of Persia was approached by the Indian Government with a proposal to construct overhead telegraph lines from Bushahr to Shiraz, Shiraz to Ispahan, Ispahan to Teheran, and Teheran to Khanikui, on the Turkish frontier, to meet a Turkish line from Baghdad. Persia did not at first welcome these negotiations, nor did Turkey desire to be united to a Persian telegraph system. At this time the political difficulties, as predicted by Sir F. Goldsmid, proved to be greater than the physical, which were afterwards encountered. Colonel Patrick

Stewart failed—early in 1862—to induce Persia to come to terms, but, at the close of that year, the Shah determined to erect the proposed line at the expense of Persia. So that at this time work was at once commenced, both between Bushahr and Teheran, under the direction of Major Champain (afterwards Colonel John Bateman Champain), assisted by Captain Murdoch Smith and Lieutenants Pierson and St. John, of the Royal Engineers, with Messrs. H. V. Walton and Man; as well as on the overhead lines from Kurachi to Gwadur by Mr. H. I. Walton, of the Indian Government Telegraphs.* It is worth noticing that one of Colonel Stewart's proposals, even at this period, was to carry a land line from Shiraz to Bundur-Abbas. Sir F. Goldsmid graphically describes in his book, "Telegraph and Travel," the difficulties met with by the working parties. Formidable hills were met with between Bushahr and Shiraz; lions were troublesome; and in the Kohrud Pass, near Ispahan, snow lay even in May; but the worst obstacles were the indifference, and sometimes the antagonism, of the authorities. In the province of Shiraz the labourers, being unpaid, deserted. No mules could be supplied, as the Governor had no money wherewith to obtain them. Another would not allow the English officers to work within the limits of his jurisdiction. For three months the Governor of Teheran would take no notice of the Shah's firman, and no mules or labourers were procurable from him. Nearly two months were occupied in getting material from Teheran to Kum, a point 85 miles distant, and no tools could be made locally without orders from Teheran. Major Champain feared the work would be paralysed, and pays tribute to the intense perseverance and patience displayed by his staff, which alone carried it through. At the Turkish frontier, on the section between Teheran and Baghdad, the Persian and Turkish Governments were in dispute about the precise line of boundary, and junction between their respective telegraph lines could not for a time be effected. Even after this was settled Lieut. Pierson, the officer in charge of the construction, was ordered by the Governor of Kermanshah to pull down some of the Turkish line and to put up Persian material instead, and later the wire at the junction was cut by his orders. However, persistent effort at length overcame

* "Official History of the Persian Gulf Telegraph Cables," by Possman.

such difficulties, and the line was completed in October, 1864. Mr. H. I. Walton, in constructing the land lines from Kurachi to Gwador, at the same period, had no easy task. The country was badly watered and sparsely inhabited, and is described as one of the most desolate and arid that can anywhere be met with.

The lines were extended from Gwador to Jask in 1869. For years they worked badly, owing to the insulators becoming coated with salt and fine dust, a common occurrence with coast lines in the tropics, but the insulators now used, which have a rim containing oil, appear to have improved communication.

I have occupied your time in recapitulating the circumstances which conspired to make the establishment of overhead lines in Turkey and Persia a difficult task, because, firstly, in the extension of these lines the same obstacles must be anticipated; and, secondly, to remind you that they have, in the past, been splendidly overcome, and the same perseverance will conquer them in the future.

Colonel Patrick Stewart laid the first Persian Gulf cable, from Gwador to Bushahr and Fao, in November, 1863, and it was completed to Kurachi in 1864. This was a gutta-percha cable* made by Henleys, 1,200 knots in length, and costing £411,751. The present electrician of the Indo-European Department considers that it was one of the best ever made. After 25 years' submersion, the gutta-percha was in excellent condition. Lieutenant—now Captain—Stiffe, of the Indian Survey, surveyed the route for this cable from Kurachi to Fao. For three or four miles, near Fao, great difficulty was experienced in getting it over the mud flats, and in digging a trench for it. In connection with the work, the name of Mr. F. C. Webb, of the staff of Messrs. Bright and Webb, who was electrician, should be mentioned. This cable, together with the Hooper's india-rubber cable, laid in 1869 from Bushahr to Jask, has had many accidents. Friction on the rocks, and consequent chafing, decay of the iron guards, the attacks of the teredo, ships' anchors in shallow water, and fish bites on the core, where the guards had rusted off, have given much trouble. Once an earthquake buried part of the cable; on another occasion a swordfish attacked and pierced the cable; and one instance was found where a whale got its tail entangled in it and produced a loop or twist. Up to 1892

the capital outlay by the Indian Government on the land lines to Jask and the Gulf cables, with the signal offices, amounted to £1,151,507. That Government had performed its share in establishing communication with Europe by April, 1864, but owing to delay in uniting Baghdad with Basra, in Turkish territory, communication between Kurachi and London was not established until February, 1865, when a message took eight and half hours in transit. Sir F. Goldsmid describes as wretched the service on the European lines, and for five years, by conferences and negotiations with the administrations concerned, endeavours were made to supply wants, to remedy failings, and to remove obstacles. Even in 1872 Colonel Champain, the Director-in-Chief of the Indo-European Department, describes the "Turkish route as hopelessly behind the requirements of the age." Messages to and from India had occupied 24 and even 48 hours in transit. The multiplicity* of routes to Constantinople, *via* Paris, Berlin, and Frankfort, led to confusion, and to the order of telegrams being inverted. There were three re-transmissions in Turkish territory, effected often by ignorant and overworked Greek and Armenian clerks, and three more between Fao and Kurachi, and those who are intimate with telegraphy will readily appreciate the liability to loss and error that these re-transmissions would involve. The line through Russia *via* Tiflis to Teheran, by which Anglo-Indian messages could travel was also wretchedly organised (1865), Russia being unwilling to spend money on it, and the clerks at the offices *en route* being ignorant of English.

In 1868, a telegraph congress was held at Vienna to fix tariffs and to arrange with the different powers concerned to regulate the Indo-European service across the Continent, but even after settling upon eight Continental routes, five for the Indo-Ottoman and three for the Russo-Persian lines, the service to and from the East still remained indifferent. In January, 1870, the delay by the Indo-European route† was over 24 hours, the difficulty of keeping the lines in order being described as worse than on the Turkish route. Between Teheran and Bushahr the line is said to have been chronically interrupted. One of the advocates of the submarine cable line briefly sums up this unhappy state of things as follows:—"The land lines were opened for

* "Existing and Projected Telegraph Routes to India," by Sir J. Andrew.

† "The Ocean Telegraph to India," by J. C. Parkinson.

* "History of the Persian Gulf Cables," by Possman.

traffic in March, 1865. By 1866, the route was quite untrustworthy. Only once in that year did a message reach Bombay in less than 24 hours from London. In 1868 the same state of things was in existence. In 1869 there was a partial improvement. Since August, 1869, and up to February, 1870, there were constant interruptions; cases of delay of 7, 10, 15, and even of 25 days occurred."

With the pioneer systems of international telegraphs, and especially those in the East, it was easy to find fault. No doubt the same experiences gained then will be reaped by those who have to carry out the Trans-continental African Telegraph, and any similar scheme in primitive and barbarous countries. But the commercial world, having tasted—by means of the pioneer lines—of the advantages of the telegraph to India, now bestirred itself. It was felt that an irregular service was worse than none at all. The success of the Atlantic cables of 1865 and 1866 had proved that an ocean cable, when carefully treated, could be relied upon as a permanent and regular means of communication, and showed, what was of immense importance in stimulating telegraph enterprise subsequently, that a heavy cable could be picked up from the ocean bottom and be repaired. The Telegraph Construction and Maintenance Company applied to Government for a guarantee towards the expenses of a cable from Suez to Bombay, 3,654 knots in length, estimated to cost, with stations and instruments, £1,100,000. It was pointed out that the necessity for taking lines through desolate countries and among semi-barbarous races would be avoided, and that, by the experience gained in the case of the Atlantic and other cables, the depth of the ocean was shown to be the best guarantee for the permanence and security of the wire. As to the objection then raised, that part of the proposed circuit would lie in Italy and France, it was explained that the traffic was guarded by conventions, and the line in Italy worked by English clerks. The cable from Alexandria to Malta was already laid, and the company was even prepared to lay one from Falmouth to Malta, to obviate the possibility of disturbance. But Lord Cranbourne, then Secretary of State for India, rejected the proposal that the Indian revenues should be applied to the guarantee, and pointed out that a large amount had been spent on the Persian Gulf cables to co-operate with other countries in completing the land line to India. Again, in July, 1867, the Anglo-Indian Telegraph

Company was formed for a similar purpose, with Captain Sherard Osborne as Managing Director. In addition to laying a Red Sea cable, this company proposed to relieve the Government of the annual payment to the old company, and to lease the Persian Gulf cables, but required a guarantee of 5 per cent. on the cost of those to be laid from Suez to Bombay. Sir Stafford Northcote, then at the India Office, could not see his way to comply, nor to accept the subsequent offer of the company to lay a cable from Suez to Massowah, for the purposes of the Abyssinian War, and to carry it on to Aden. But out of these negotiations one practical advantage issued. A frigate of the Royal Navy was sent to sound between Bombay and Aden for a suitable course for a telegraph cable. In April, 1868, the City of London again renewed the attack. There was a general outcry against the state of communication *viâ* Turkey and Persia with India. A memorial, signed by the Lord Mayor and many of the merchants of London, advocating the cable, was presented to the Secretary of State by Mr. Crawford, M.P. The main points to which attention was invited was the participation, under the then existing system, of many foreign Governments in the maintenance and administration of the land lines, involving confusion and irregularities, and the liability of India being cut off in time of war from England. No satisfactory reply was received, the recollection of the obligations assumed for the first Red Sea cables being then too lively.

There were those who foresaw that in times of peace, at all events, the overhead lines, if well administered, would go far to meet commercial needs, and thanks to an eminent firm of telegraph engineers and manufacturers, Messrs. Siemens and Halske, of Berlin and St. Petersburg, a concession for a term of 25 years was obtained from the Russian, Prussian, and Persian Governments, for the purpose of uniting Teheran and the lines of the Government of India with those of North Germany, which Prussia agreed to erect. England and the Continent would thus work direct, through a specially reserved circuit to India. The system was to be under English management. Out of this arrangement grew the Indo-European Telegraph Company, formed in April, 1868, with a capital of £450,000, which has, now that the difficulties of the initial work have been overcome, provided an excellent service to and from India, *viâ* Lowestoft,

Emden, Berlin, Odessa, Kurtch, and Teheran, in conjunction with the Indo-European Government department, which controls the circuits from Kurachi to Teheran. The improvements in the latter are largely due to the efforts of Mr. Ffinch, for the last eighteen years Deputy-Director of the Persian Gulf section; of Lieutenant-Colonel Wells, R.E., occupying a similar position in Persia; and of their efficient staffs. The overland lines have in the past suffered both from wilful damage and from snowstorms; and, as I have mentioned above, the Persian Gulf cables give no rest to those charged with their maintenance; but the constant vigilance of the officials of the two administrations has certainly been rewarded by the speedy and accurate service now afforded.

But it is a fortunate thing for this country, and the Empire in general, that enterprise provided an alternative route for the telegraph to India, exposed, it is true, to many unforeseen dangers from the vagaries of nature in the ocean bed, but safe, on the whole, from molestation by man.

To those who came forward in the years 1868 and 1869 to subscribe £2,000,000 for laying cables from England to India, the gratitude of both countries is due. Had the scheme failed it is most probable that the telegraph service would still have remained slow and irregular; but the issue being successful, the healthy stimulus of competition came into play. I believe that Sir John Pender, whose name is so well known in the cable world, and under whose able direction many of the cable systems have flourished, Sir R. Glass, Sir George Elliot, Sir Daniel Gooch, Sir James Anderson, and a few others, subscribed £400,000 of the required capital. The Fal-mouth, Gibraltar, and Malta Telegraph Company was formed in July, 1869; the Anglo-Mediterranean Company in May, 1868 (for a cable from Malta to Alexandria); and the British Indian Telegraph Company, for uniting Suez and Bombay, in January, 1869. The total length of the cables was 6,456 knots. The *Great Eastern* left Portland on the 6th November, 1869, with over 2,000 miles of cable, accompanied by three other steamers, and by the 15th March, 1870, Bombay was in communication by cable with England. The various companies above referred to were amalgamated in November, 1872, under the title of the Eastern Telegraph Company. Communication was successful from the outset. The marvellous skill

shown in contriving appliances by which the retardation caused by electrical charge and discharge of a cable could be overcome was such, and the instruments by which feeble undulations could be recorded so delicate, that even in the years 1872, the cable from Aden to Bombay, 1,818 knots, could convey messages more quickly than could a wire of less than half that length from Bombay to Madras. As an instance of the celerity with which a telegram could be received from England, I may mention that on the evening of Derby day, 1872, when a few of us were watching for the news in the Calcutta Telegraph-office, Reuter's telegram, with the name of the winner, arrived a few minutes after the horse had passed the post. The success of the cables, financially, was at once secured; in 1872, a dividend of 6 per cent. was paid on the capital stock. The service has been rendered still more perfect since then by the duplication of the cables throughout, and by a third from Suez to Bombay, laid within the last three years.

Yet another company for carrying the telegraph to the East was formed in 1869—the Great Northern—to connect England and France with the north of Europe, China, and Japan, with a capital of £1,500,000. Its land lines cross Russia and Siberia to Vladivostock, whence a cable proceeds to Japan, and another to Amoy. This telegraph, which affords another route to India, by way of Hong Kong and Singapore, through the cables of the Eastern Extension Telegraph Company, has also been a decided financial success. In 1874, 5 per cent. was paid on the capital, and larger dividends have been earned since. At the present day, there is another line through Siberia, connecting China and Russia, and one projected, which will be the shortest route from Pekin to Europe.

If you will permit me now that I have dealt with the historical portion of the subject, I will touch upon the tariffs, traffics, earnings, and profits of the lines, with other kindred details.

When communication between England and India was first opened, the unit of charge was a message of 20 words for £5, or at the rate of 5s. per word. In 1868, on the formation of the Indo-European Company, it was proposed to charge £3 10s. for 20 words, but the Congress at Vienna fixed the rate at £2 17s., and introduced the ten word messages for £1 17s., equal to 3s. 9d. per word. After the cables were laid *viâ* Suez, and it was found that the Indo-European Telegraph Company had been

earning less than was sufficient for the maintenance of their lines, the Congress at Rome in 1871 raised the charge *viâ* Suez and *viâ* Teheran to £4 for 20 words, and to £3 10s. for 10 words; and *viâ* Turkey to £2 17s. and £1 17s. respectively. In 1876 the minimum chargeable unit was reduced from 10 words to one word, containing not more than ten letters, but the charge was fixed at 4s. 7d. This was a distinct improvement, since a message, consisting of as few as three chargeable words, could now be sent. Evidently the public appreciated the alteration, for in the year 1876-77, although the average value of each message had decreased 12 per cent., still private senders despatched 22·4 per cent. more messages, and the gross value was increased by 5·3 per cent. In 1887, the charge was 4s. 2d. per word, and at the present time from England to India the rate is 4s., *viâ* Suez and Teheran, and 3s. 8d. *viâ* Turkey. From India to England the corresponding rates are Rs. 3/4/- and Rs. 2/15/-. The charges in India are altered from time to time by the Government, to prevent loss by exchange, since payment must be made to the companies in gold, a proceeding which is unwelcome to the commercial community, and which, when applied in South America, was resented, and had to be abandoned.

As regards the revenue afforded by messages in the early days of the overland telegraph, I have not complete figures. But, in 1868, the Indo-European Department and the Turkish line earned something like £187,200. The opening of the Suez route at once diverted a large portion of the traffic, and it also stimulated it. The Eastern Telegraph Company has never paid less than 5 per cent., and often more than 6 per cent. The Indo-European Company, although for a few years unremunerative, was able to pay 5 per cent. in 1874, has not paid less than 8 per cent. since 1880, and as much as 12 per cent., and in the past five years often 10 per cent. The returns for the Turkish lines are not available, but a small percentage only of the overland traffic between Europe and the East now passes over them. In 1891-92, 92·4 per cent. went *viâ* Teheran, and 7·6 per cent. *viâ* Turkey; but this is fully accounted for by the fact that the mean rate of transmission in that year by the former route was one hour, and by the latter sixteen hours. It may be remarked in this contrast that the Indo-European Department, controlling the lines from Kurachi to Teheran, has been

of late years only able to show a credit balance. In 1891-92, the net profit was 1·4 per cent. This is due to the heavy outlay on the Persian Gulf cable, and this is an important factor in determining the telegraphic rate to India. In 1878, an agreement was effected between the Eastern and the Indo-European Companies and the Indian Government for a "joint purse," based on the actual traffics each line dealt with. By this arrangement the Eastern Company gets 60·39 per cent. of the revenue for Indian traffic, and the other company, with the Indo-European Department, 39·61 per cent.; for trans-Indian, or Far East traffic, the figures are 80·53 and 19·47 per cent. respectively. The actual percentages of traffic since carried differ from these figures. The averages, from 1878 to 1892, for Indian messages are 56·5 per cent., *viâ* Suez, and 43·5, *viâ* Teheran. Although the Cable Company may have had a larger share of the earnings than the actual work done would justify, still it must not be overlooked that the support it has afforded to the overland lines in times of interruption has been immense, and the co-existence of the two routes (leaving the Turkish aside as being comparatively unpopular) has proved to be indispensable in retaining and in fostering the traffic.

The amounts earned and paid into the "joint purse," on account of Indo-European messages for some of the years, from 1878 to 1892, are given below :—

1878-79	£310,009
1881-82	360,011
1888-89	335,257
1891-92	360,098

In 1891-92, the share of the Eastern Telegraph Company was £217,465; of the Indo-European Company, £80,445; and of the Indo-European Department, £62,188. If the overland lines had retained all they earned in that year, their shares would have been £106,488 and £81,760 respectively. All administrations concerned earned something more for Far East traffic, with the Straits Settlements, China, Australia, New Zealand, &c., the share of the Eastern Telegraph Company on this account being £229,045, of the Indo-European Company £34,218, and of the Indo-European Department £21,164. The dividends paid by the first two were at the rate of 6½ and 10 per cent. respectively.

The capital, including ordinary, preference, and debenture stock of the Eastern Telegraph

Company, was, in 1891-92, £6,100,000, and its reserve fund £442,014. The capital of the Indo-European Telegraph Company remained at £425,000, and its reserve was £172,839. These last figures, coupled with those of the excellent dividends distributed, and also the admirable service afforded by the company will show what land lines can do when well administered. The capital expenditure by the Indo-European Department, up to the year under review, was Rx.1,150,000.

The figures given above include the revenue derived from Continental messages as well as those of the United Kingdom. Supposing the number of telegrams to be proportional to the whole value of the trade, then, in 1892, one quarter would have been sent between India and the Continent and three-quarters to or from the United Kingdom. Thus out of the revenue for 1891-92 for Indian traffic, £270,000 was approximately contributed by Anglo-Indian and £90,000 by Indo-Continental messages. I would ask attention to these figures, since they are material to the subsequent argument.

Now, I have little doubt that it will surprise most to know that the total amount paid for telegrams between India and the United Kingdom in 1891-92, namely, £270,000, was only about quarter per cent. of the value of the total trade, Rx. 95,222,155. I attribute this unnatural restriction of traffic solely to the high rate which prevails. Small traders cannot, on account of the expense, use the wires, and I think my friends in India will bear me out in the statement that foreign telegrams are, as a matter of fact, sent by the comparatively few wealthy firms. Private persons, owing to the cost, rarely communicate between England and India by telegraph.

Now, the last twenty years have witnessed an extraordinary extension of inland telegraphs in both countries. Speaking from experience in India, I can say that they have largely aided in the transport of produce, and in bringing up-country merchants into connection with distant markets, with which formerly communication was difficult and slow. In order to make a profit at the present day it is often necessary that transactions should be effected quickly, and whenever telegrams are made cheap it has been found that they are readily used for this purpose. Moreover, native firms are learning to deal direct with European manufacturers. Could they communicate by telegraph, at a low charge, there can be no doubt that the trades

concerned would receive a stimulus. It is, perhaps, open to doubt, whether it would be a public benefit to afford cheaper means than exist at present by which the Secretary of State could speak to the Viceroy of India. There would, however, be a large reduction in the present considerable telegraph bills of the two Governments; and they should be, equally with the general public, interested in lowering foreign telegraph rates.

The inland telegraph traffic in India, in the last 20 years, has increased from 684,388 to 3,441,637 messages; while that exchanged between that country and Europe has increased from 50,462 to 193,782 messages, by all routes. This number, it must be noted, include all Indo-European official, commercial, press, and domestic messages. Thus, setting the Continental traffic aside, India and England only exchange about 465 messages per working day. This fact, when compared with the volume of their mutual trade, and with the enormous political interests common to both countries, speaks for itself.

Now, with effect from 1st May, 1891, some of the Australian colonies entered into an agreement with the telegraph companies to make up half the loss, if such loss should occur, on a reduction of charge from 8s. to 4s. per word between England and Australia. The difference was a large one, and experience has shown that a certain loss has been incurred, but that if the reduction had been spread over ten years instead of being wholly effected at once, there would have been no loss. Probably in a shorter time than that the increase of traffic would have paid for the reduction. From the 1st January, 1893, the rate was raised to 4s. 9d., at which it is anticipated there will not be a deficit in the revenue. I believe the situation is one in which the Home and Indian Governments might, in their own and in the public interest, exert themselves. Apart from the cheapening of communication by extending the overland lines, a course which is quite practicable, I hold that the companies are in a position to gradually lower the rate, and that experience proves that, done cautiously, the greater facilities thus afforded will prevent loss of revenue.

The question next arises—What amount of traffic could be easily carried by the Indo-European and Eastern Companies with their existing lines, should the introduction of a reduced rate largely augment the number of telegrams? I will suppose that two out of the three cables are used for through traffic to

India, and that there are two through wires *via* Teheran. These four working circuits are capable of carrying at least each fifteen words per minute, or say, to give you a better idea of their capacity, one message per minute. In 24 hours a traffic of 5,760 messages could be dealt with, or five times what passes at present between Europe and the East. But there is another feature in modern telegraphy by which, without increasing the capital outlay by more than a small sum—£15,000 in the case of the Eastern Company's cables—the carrying capacity of the circuits is almost doubled. This is the "duplex system," which by special arrangements of apparatus at the ends of a circuit, but involving no alteration of the wire or cable itself, permits of messages being transmitted simultaneously from each end. Dr. Muirhead's efficient duplex system, which was applied to the Eastern Company's cables some twelve years ago, about doubles the carrying power of a circuit, I am informed, and thus the company is in a position to carry a very large traffic without going to the expense of laying extra cables for it. Many will think that the public might have been allowed to participate in the advantages accruing from this new method by the concession of lower charges. Anyhow, it affords means of now dealing, in conjunction with the Indo-European Company, with over 7,000 messages daily. The lines of the latter are not, I believe, at present using the duplex system, but there is no difficulty in applying it, and increasing largely the ability of the company to cope with a large traffic. Then the Turkish route, in capable hands, can be made as serviceable as the others. It is quite possible that, owing to telegrams on business being despatched during working hours, the bulk of the traffic will be confined to part of the day only, and, at the same time, desirable that it should not be allowed to accumulate. Supposing even that it is dealt with between 11 a.m., London time (*i.e.*, 4 p.m., Indian time), and midnight. Then the present circuits duplexed could carry over 4,000 messages in that interval, with no excessive delay on each. Were all these Anglo-Indian messages, a rate of two rupees, or two shillings and sixpence per word, would produce a revenue of £6,850 per day, taking each message to consist of 13·7 words, as was the average for private messages in 1891-92, or over £2,000,000 for the year of 300 working days, which, after deducting the Indian Government share, would leave some-

thing like £1,750,000 to be divided between the companies, against £650,000 at present. Of course, I am aware that even at a rate of 2s. 6d., the traffic is not likely to increase with so great a bound, but there is little reason to doubt that with India, as well as the Far East, it will be worked up to in twenty years, if charges are substantially lowered at intervals in that period.

With a growing foreign trade, the revenue in 1891-92, from Indo-European traffic, was about the same as that for 1881-82—about £360,000. Some will attribute this to the process of condensation, or codification, which has been going on, that is, the use of letter or word cipher. No doubt this has unfavourably affected revenues, but then it is a science fostered by high tariffs. I am prone to think that the want of progress is rather due to the fact that there has been practically little reduction in cost per word for twenty years. I venture to assert that, in existing circumstances, looking at the dividends paid, the substantial reserves accumulated, the reduced cost of cables, as compared with twenty years ago, and at the fact that the lines can carry a much larger traffic than they do, the public has a claim, and the companies and the Governments of India and this country have an interest in making Anglo-Indian telegrams cheaper. I would add that the Indian public ought to be relieved of fluctuating charges for the messages, made to depend upon the course of exchange. The charge can, and should be reduced by 6d. yearly, until the present rate—4s.—is lowered to 2s. 6d. This course would obviate any serious falling-off in receipts. No guarantee by Government, nor by the commercial communities concerned, should be required to insure the companies against loss in taking this step. Their present position is sufficiently strong financially to admit of their incurring the risk.

I have recently been favoured with the opinion of the Madras Chamber of Commerce regarding the present tariff. It "considers that the present Indian rate of Rs. 3 4a. per word is far too high, and that it would not be unreasonable to ask for a fixed rupee rate of Rs. 2 4a., considering that a large proportion of the telegraph company's (*i.e.*, the Eastern Company's) expenditure is in rupees. The Chamber does not view with favour the present system of a tariff fluctuating with exchange." This is the opinion of many others connected with trade in India, and any

one who may care to inquire will, I think, discover that there is at the present time a positive reluctance to resort to the telegraph, instead of the hourly use of it becoming habitual, as a low tariff would bring about.

But, in my opinion, what is essential to the introduction of a permanently low charge is the extension of the overland systems of telegraphs. I desire to point out that there are three links to be completed in these systems, which would, with a properly organised service under central control, in connection with the European lines, certainly afford means to India and England of exchanging correspondence far more cheaply than at present. They are as follows:—Shiraz to Jask, in Persia, 575 miles; a telegraph line by this route will, at a cost of £35,000, complete the overhead wire from London to Calcutta, with the exception of the short cable across the Channel. This amount is less than the cost of maintenance of the Persian Gulf cables for two years. When such a line was well and strongly established, the cables from Kurachi to Gwadur could be taken up and used elsewhere. In the end, even if the cables were abandoned, there would be a positive saving to the Government of India on the cost of maintenance, and of some of the telegraph station establishments on the Gulf, for only two repeating offices would be required between Kurachi and Teheran. A new trunk line from England to India, *viâ* the Continent, Russia, and Persia, with the necessary offices, would not, in the light of the experience we now have, and at the present chief prices of materials, cost more than £450,000. The Home and Indian Governments might possibly find it economical to construct such a line, primarily for their own correspondence. I would remind you that there are two wires by land already—from Kurachi to Jask, and from Shiraz to Teheran.

Mr. J. K. Preece, then of the Telegraph Department, and now Consul at Ispahan, made the journey from Shiraz to Jask, *viâ* Bunder Abbas, in 1884. His account is in the "Proceedings" of the Geographical Society for January, 1885. He found no difficulty in travelling from Shiraz to Bunder Abbas; villages were numerous, supplies plentiful, climate pleasant, and, he says, "the people everywhere have been most civil and obliging, all doing their utmost to help me." From Bunder Abbas to Jask the road was more rough, owing to the small rivers being swollen with rain; but villages were frequent, and the

people civil. Mr. Preece noticed—this was in 1884—that the towers and walls of the villages were falling to decay, and he took this for a sign that the Persian tribesman and Biluch marauder were becoming amenable to the law; he saw change going on in the right direction. Mr. Preece considered that, for a railway, the route from Shiraz to Bunder Abbas, through a large grain-growing country, is better than that from Shiraz to Bushahr, which is now followed by the telegraph. Sir F. Goldsmid, in his remarks upon Mr. Preece's narrative, favours the coast line from Jask to Kurachi for a railway to meet a probable future one from Constantinople to Baghdad and Shiraz. Colonel Champain, then Director-in-Chief of the Indo-European Telegraph Department, then thought that the land line from Shiraz to Jask was practicable, and that the troubles with the Persian Gulf cables would, if that line were made, be largely obviated. The Hon. George Curzon thinks there would be a certain amount of injury to be apprehended by nomad tribesmen at first to a telegraph line from Shiraz to Jask; but that the payment of small subsidies, as is done with such good results in the case of the line from Jask to Kurachi, would go far to secure its safety. Mr. Curzon considers the security largely dependent upon the manner in which the Persian Government would interest itself in the maintenance of the line. Between Shiraz and Teheran acts of wilful damage have, through the constant vigilance of the authorities, of late years much diminished; and in other parts the same influence could no doubt be brought to bear.

The second link, which it is important to complete, is that from Mashad to Herat, and thence to Kandahar and Quetta. From Teheran to Mashad, 562 miles, there is now a telegraph line belonging to the Persian Government, but maintained by the Indo-European Department. The interruptions of this line, mostly occasioned by camels knocking down the posts, are excessive, but are becoming less. It is known by experience that a line can be made strong enough to obviate such accidents. Mashad sent about 2,000 messages to the Persian Gulf stations in the year 1891-92, a fact which shows that when these out-of-the-way places are connected by telegraph with trade outlets, the local traffic is an important item in estimating revenue. From Mashad to Herat is about 240 miles. Mr. Curzon informs me that the road is very much travelled, and

that neither itinerants nor inhabitants would be likely to take exception to telegraph poles and wires. From Herat to Quetta, *via* Kandahar, some 500 miles, there are no physical difficulties; and there is every likelihood that, before long, the present Amir will look favourably upon the introduction of the telegraph, equally with other applications of modern science, into his dominions. At Quetta, the lines of the Indian Telegraph Department are connected with the Punjab and with Kurachi. I shall be told that the telegraph work in Afghanistan is perilous. No doubt at first it will be. The telegraph operations in Burma have been difficult and hazardous, but most of the lines are now permanent and reliable.

In the Afghan war, Mr. Luke, of the Indian Telegraph, managed to keep the wire open from Kabul to Peshawur, and Mr. Pitman, at Kandahar, held communication with Kurachi. The difficulties now to be encountered, with a Government favourable to the enterprise, would be comparatively light.

There remains one more important gap to be filled up in the Asiatic systems of telegraphs, namely, that from Merv to Herat *via* Penjdeh. These are joined by a road about 240 miles in length along the valley of the Murghab. A telegraph line here will, when Herat is connected to Quetta, unite India with the present Russian Asiatic telegraphs that lead to Europe by the Caspian Sea. A second trunk line through European Russia, *via* Merv and Herat, and so to India, will afford a valuable alternative route in time of peace, and by this, in combination with the line of the Indo-European Company, or another through the south of Russia and Persia, the whole of the traffic between Europe and the East could be carried. Such lines would probably earn much from local traffic. The cost, not more than a million sterling for the two separate lines, would admit of messages passing between England and India at a shilling per word, with provision yet for interest, at the rate of 8 per cent. on the capital.

It is essential to the success of the working of long lines passing through foreign territories that they should be administered by one responsible directorate; and existing circumstances point to the Home and Indian Governments, as well as the company that has already achieved such good results, as the authorities best qualified to promote telegraphic enterprise in the localities I have indicated. No time should be lost in acquiring

the rights to do so. By diplomacy and the timely grant of small subsidies, the exclusive appropriation by these routes of certain wires for an international service could be secured.

NOTE.—After preparation of the above paper a letter was received by me from the Bombay Chamber of Commerce, on the subject of rates for telegrams. The following is an extract:—"This Chamber has frequently made representations to the Government of India with the view of endeavouring to obtain a reduction in rates of telegraphy between India and Europe, which they consider excessive, but hitherto, owing to the monopoly enjoyed by the Companies, without avail. The Chamber entertains not the slightest doubt that a fair reduction in rates would lead to an enormous development of traffic, and, probably in the end, prove no loss whatever to the Companies."

DISCUSSION.

Sir OWEN TUDOR BURNE, K.C.S.I., on behalf of the governing body of the Imperial Institute, desired to express the obligations they were under to the Council and members of the Society of Arts for allowing some of their lectures to be delivered in that hall. Among other observations, he said that he was able, after a long official experience, to corroborate all that Mr. Walker had brought forward, as to the necessity for cheapening telegraph rates, and as to the quickness of communication between England and India, mentioning an instance, some years ago, of a telegram being despatched and a reply received within seven minutes.

Mr. MARTIN WOOD said, as a member of the Society of Arts, he was glad to hear Sir Owen Burne acknowledge so fairly the obligation of the Institute to the Society for this lecture of Mr. Walker's. It afforded a comprehensive review of a truly Imperial subject, and amongst other passages, he was glad to hear the references made in the paper to the difficulties which some of the pioneers of telegraphic communication with the East had to go through. He remembered, for instance, the enthusiasm which the name of Colonel Patrick Stewart always created among those who had been associated with him, and also some of Sir Charles Bright's staff in the Persian Gulf. He believed there was still a charge on the Indian revenue of about £18,000 a year for that early company, which only acted for about a week. He hoped some means would be found for relieving the taxpayers of India from that charge, though he did not know how this should be met, whether from future profits of Government lines, or what else, but it was too bad that India should be paying all these years, now nearly two lakhs and a half, for no service whatever. He had been much in-

terested in hearing the mention of the laying of the cable from Suez to Bombay, because it was his own fortune to be on board the *Great Eastern* when it was done, and as Captain Galpin, who then commanded that once noble vessel, had only recently died, it was only fitting to recall his memory. All on board the ship could testify to the great ability with which he carried out that important work. There was one practical object that might be furthered by the reading of this paper, namely, some appreciable reduction in charges for telegrams to the East. This was no mere outside claim for cheapness, for Mr. Walker had shown good reasons for such reduction, based on his own intimate experience of the subject.

Mr. B. T. FINCH said after this interesting and exhaustive paper there was very little for him to add. With regard to the reduction of the tariff to India, he was not in a position to say what might eventually be done, but he knew the subject was one in which the Government of India took a great interest, and that they were constantly watching events. Tariffs were generally considered, and reduced or increased at the Telegraphic Conferences, which took place every five years. The next conference should have taken place next year, but had been postponed till 1896, so that he feared until it met, no alteration could be expected. It must be remembered that the Eastern Telegraph Company had spent large sums of money on their line, and their capital was over £6,000,000. Submarine cables would not last for a very long period, especially when laid in such seas as the Red Sea and the Persian Gulf. Mr. Walker appeared to think that a land line was perhaps better than a submarine cable. It undoubtedly was cheaper, but it must be remembered that the land lines through a great part of the way between India and England traversed countries where there were no railways and no roads. The coast, which extended 700 miles from Kurachi, was one of the most desolate and arid tracks of country in the whole world. When that line was first built in 1862, the Beluchis were not so well known as they now are, and it was the object of the working parties to construct the line as near the sea as possible. They had the sea on the left hand and a range of mountains on the right, which eventually merged into the sea. As the line was being constructed, they got nearer and nearer to the range of mountains, and eventually came to the foot of the cliff which ended in the sea, and the difficulty was how they should take the line on. It was decided to lay a submarine cable round the cliff, which was done, but the rocks very soon cut through the guards, and the cable was interrupted. A second cable was laid, which quickly shared the same fate. In the meantime a path up the mountain from the west side was discovered, and after improving it somewhat the posts and wires were carried to the top, but when they came to the east cliff it was found to be about 2,000 feet deep, down which they

had to throw the wire. It used to take a Beluchi, accustomed to hill climbing, five days to go overland from the post at the bottom to the post at the top. This line, also, was very unsatisfactory, as rocks were constantly falling on it, and they next turned attention to another pass called the Buzi Pass in the native language, the Ass's Pass, he believed, because a donkey had once been ass enough to go that way. He sent an assistant there, who got to the top of the mountain, but he told him that although he arrived late at night, and dead tired, he was unable to sleep, because all night long he was thinking how he should get to the bottom again. In other parts of the country there were salt plains which much interfered with the good working of an overland line. The cables on the other hand had their own peculiar difficulties, such as had been mentioned in the paper. Although these lines were laid in such an unfavourable country there had been no total interruption on the Persian Gulf line since 1885. In Persia they had to go over four mountain passes to get to the plateau, and down another to reach Teheran, the elevations being from 7,700 to 8,800 feet. Mr. Walker had told them what kind of country Persia was, but he would read a passage from a report by his former chief, Sir John Bateman-Champain, which would perhaps present the case in even more forcible colours:—"The heat in summer is nearly as distressing as in India, and the Inspector on his urgent repairing trip can hope for no shady tree nor for a single stream of water. As a general rule, with few exceptions, his way lies over glaring salt or stony deserts, or under scorching barren rocks. In winter, the cold on the mountain ridges and elevated plains is as trying as, and perhaps more dangerous than, the heat of summer. In severe seasons the passes are occasionally so blocked with snow that no native traveller dreams of pursuing his journey, but the telegraph official is bound to force his way through obstacles which are an effectual bar to ordinary traffic. The wretched caravanserais, or hovels, where shelter can be found lie apart from one another 20 or 30 miles, and in many parts of Persia there are no intermediate villages. The inhabitants are not inclined to be hospitable, and the difficulty of procuring help, supplies, or lodging, is indescribable. The roads and tracks are generally as bad as possible, and wheeled conveyances are unknown. The risk to life in crossing snow drifts is great, and the privations which must be endured when, after struggling in a bitterly cold temperature all day, the nights have to be passed in some wretched hut, or even cave, with barely enough fuel or food to support life, can scarcely be imagined. It was after a week of such work that Mr. Hamilton, a clerk at Dehbeed, formerly a sergeant of the Royal Engineers, died from inflammation of the stomach brought on by cold and exposure." Since 1886, however, the Persian section of the line had only been interrupted once for nine hours. In his opinion they should devote attention more to

the Turkish route, which was the easiest to the East, if they could only persuade the Turks to allow it to be put in good order, and have English clerks work it for them.

Lieut.-Col. H. L. WELLS, R.E., M.I.E.E., said he could perhaps give a little more information with regard to Persia. Mr. Walker had referred to the case of one of their officials being murdered, that was in 1872, and he must say in defence of the Persians that in that case it was the man's own fault. Two sergeants were shot, and in one case the Englishman was entirely to blame, and in the other a man died bravely defending his possessions. Being a soldier he preferred fighting to parleying, though his opponents were six to one, and naturally he had to succumb. The wilful damage in Persia, which at first was very great, was now not worth serious notice. Since he had charge of that section there had been only one case of total interruption from that cause, and this was due to some person, who thinking he owed a grudge to the local governor, cut the wires. In another case, to which Mr. Walker referred, where the local governor from spite against the Government tried to damage the line; he only smashed three or four posts and forgot to cut the wires, which were only rendered unworkable because they were lying jumbled together in the muddy ground. Nowadays, thanks to Cardew's sounders, they could work through long distances even when the line was lying on damp earth or snow. In Sir John Champain's and Sir Robert Murdoch Smith's time the natives were very bigoted, but little by little the Telegraph Department had found its way into their affections. The officials, like all Englishmen, were hospitable, and they liked to speak and chat with their neighbours, and by degrees they became the confidants of the villagers, and even by the governors were much looked up to. When the tobacco régime came to an end, and a great feeling was expressed against all Europeans institutions throughout Persia, the Indo-European telegraph was specially exempted by name. The lines were unprotected for hundreds of miles, but no fanatic interfered with them, or even smashed an insulator. Only last spring a typical case occurred, when a revolution took place owing to bad government in the province of Fars. The people, as usual, flew to the representative of the Indo-European telegraph, and sent messages to the Shah, knowing that in this way their complaints would be heard. The officials were sometimes placed in rather a difficult position, in this way having to represent rebels; but still the truth did get to the Shah by these means, and generally had a beneficial effect. Governors had been spared from unjust punishment, and the population had been freed from tyrannical masters through the operations of the telegraph. The line from Shiraz to Jask would, he was sure, be welcome; but before it could be undertaken with success, the government must, as the Hon. George

Curzon insists, be more strict than at present, for last year the whole of the Shiraz to Jask country was in revolt; and the line, if made, would be subject to all sorts of difficulties, until the Persian Government took this district into its hands; at the same time, making the line might conduce to that end. The Shah took interest in the telegraphs and electricity. He had the electric lights in his theatre for passion plays; telephones were well known, and a network of telegraph wires ran throughout the country; but, owing to mismanagement, the want of funds, and the speculation, which was chronic, they seldom worked satisfactorily. The Meshed line, to which Mr. Walker had referred, was now under the charge of the Indo-European Telegraph Department. Before he left the country, the Shah handed over to him 10,000 tomans (a toman being worth about 6s.), to be spent in three annual instalments on the line, in addition to the annual outlay. The Shah had lately started a second line, *viâ* Shiraz and Mohammera, making the connection with the Turkish lines. He was glad to find that Mr. Walker, as well as Mr. Finch, were in favour of land lines. He was quite sure that land lines were better than cables for commercial work; notably, the speed on them is better, and they are so quickly repaired. The Indo-European system had continually taken up the work of the cables when they broke down. Year after year, until quite lately, as soon as the monsoon came round, a total interruption of the Eastern telegraph system used to occur (until within the last two years), and when that occurred the land line came to their aid, and carried the whole traffic. In 1882, during the Egyptian campaign, when Arabi's men cut the line connecting Suez with Port Said, the only means of communication between General Wolseley, at Port Said, and Admiral Hewett, at Suez, was *viâ* Aden, Bombay, and Persia. Each morning they used to clear the line, and those two chiefs had a talk with each other. He was then temporarily in charge at Teheran, and remembered the bread riot which occurred at a small town 200 miles to the south, which looked as if it would be the cause of a total breakdown of communication between the Eastern and Western world. The rioters seized the telegraph clerk and held him to his desk, and insisted on an immediate reply to their petition to the Shah; others climbed the post and said, if they did not get an answer within ten minutes, they would smash the lines; and it was only by the official's excellent knowledge of the language of the people, and the esteem in which he was held, that he was able at last to persuade them to wait until their petition could be forwarded to the Shah, who was away some distance from Teheran. Some years ago when all the lines in England were interrupted by heavy snow storms, an inquiry came *viâ* Bombay and Teheran from Cornwall, to know what London was about. Mr. Walker had referred to the ease with which a line could be carried through Afghanistan, but he feared there would be more difficulty than Mr. Walker anticipated, there were so many

tribes at variance with each other, and he feared for a long time they would come and damage the line in the hope of the blame attaching to their neighbours, this being a favourite trick with that sort of people. He was not so much in favour of a line *via* Meshed, Herat and Candahar, as of the Turkish lines being prolonged. The former would be essentially a peace line, for as soon as there was war, enemies to Persia or England could in 28 hours send a dozen horse-men across the frontier and cut up the wires and carry them off. The Cyprus, Aleppo, and Euphrates Valley route connecting with Baghdad, Jask, and Kurachi, through Southern Persia, would be the better route.

The CHAIRMAN, in proposing a vote of thanks to Mr. Walker for his admirable paper, said he had brought the history of telegraphic communication with the East up to date, and had made some most valuable suggestions which, no doubt, would be acted upon at no distant date, both with regard to the extension of the system and to the economy which would attend it. In reading his observations on this point, the idea occurred to him that it would be better if his friend Sir John Pender had been asked to preside, because he would be likely to bring more influence to bear on the main object which Mr. Walker advocated than any one else. Probably if some gentleman came forward hereafter to read a paper on cheap passage and freight to India, Sir John Pender would be asked to take the chair. Looking at the question of telegraphing from the point of view of a shipowner, he was amazed to find that whilst it was possible to send a ton of merchandise from London to the uttermost ends of the earth for something like 50s., it cost 20s. to send a message of five words to India. It must have occurred to many who saw the wonderful manner in which the telegraphic system had developed, and the great improvements which had taken place through the opening of the Suez Canal, and the acceleration of steam communication to all parts of the world, how absolutely useless the telegraphic system would be if to-morrow they were relegated to the days of sailing vessels, and the Cape of Good Hope route. In 1867 or 1868, when telegraphic communication was first opened with North China, through Russia, he happened to be residing in Shanghai, and should never forget the astonishment of the Chinese people on discovering that they could not only obtain news of the European markets in that way, but also remittances. The system of transacting business by bills had been almost obliterated by the system of telegraphic exchange which now existed. On the occasion of the Russian scare, which took place in 1885, the Government and the Navy were, as usual, unprepared, and it was found necessary not only to engage in this country many of the fastest vessels connected with the Atlantic trade, for the purpose of arming them as cruisers, but also to telegraph and engage vessels in Sydney, Hong Kong, and the Cape, and

it was within his knowledge that the vessels in Sydney and Hong Kong were engaged and armed, and the men were practising their guns at sea, before the guns were placed on board the auxiliary vessels in Liverpool. That showed how dependent we were on the electric telegraph for the security of the empire. With regard to the suggestions made for the extension of numerous lines and additions *via* Persia, Russia, Central Asia, and so on, he thought it would never do for this country not to have an independent line of its own, solely devoted to its own service, for the purposes of peace or war.

The vote of thanks was carried unanimously, and briefly acknowledged by Mr. Walker.

Mr. CHARLES BRIGHT, Assoc.M.Inst.C.E., writes:—Though present at the meeting, I had no opportunity of taking part in the discussion. I would point out that Messrs. Bright and Clark were engineers to the Indian Government, in connection with the first Persian Gulf cable, and that this cable was laid in 1863, under the personal superintendence of the late Sir Charles Bright. The late Mr. J. C. Laws was his principal assistant, and he was further assisted by the late Mr. F. Lambert and Mr. F. C. Webb, besides several others. The late Colonel (afterwards Sir Patrick) Stewart, R.E., was at the time Chief Director of the Government Indo-European Telegraph, and in that capacity alone he was acting with reference to this cable, together with Colonel (now Sir Frederick) Goldsmid, the laying of which was, however, entirely in the hands of Sir Charles Bright, on behalf of Messrs. Bright and Clark, after a careful survey had been effected by Lieut. (now Captain) A. W. Stiffe, of the Indian Navy. For further information concerning this expedition I would refer to Sir F. Goldsmid's engrossing book, "Telegraph and Travel." The first Persian Gulf cable is of historic interest, in that it was the first cable which was a complete success from the outset, no hitch whatever occurring during the construction or laying of the same. Moreover, this was the first cable which underwent a proper system of testing during manufacture, the testing instruments being also more delicate than those previously used. Every joint was, for the first time, tested by the accumulation test of Mr. Latimer Clark, F.R.S. The copper conductor gave an average conductivity (or purity) of 90 per cent.; in previous cables this had been as low as 40 per cent., and under. To the design of Messrs. Bright and Clark, the conductor (225 lbs. per N.M.) was built up in a segmental form, with an outer surrounding tube, the whole being drawn down to a circular form, thus combining the electrical advantages of a solid wire with the mechanical advantages of a strand. Several practical difficulties were found in the construction of such a conductor, however, and the

expense of a special wire of such a form was also very great. Messrs. Siemens Bros. have since adopted a conductor based on the same principles: having a large centre wire surrounded by small wires. It was in connection with the Persian Gulf cable that Messrs. Bright and Clark first made experiments with gutta-percha at different temperatures, which led to the logarithmic curve law for the variation of electrical resistance of such substances by temperature. It was in this cable, too, that Bright and Clark's bituminous compound was first used. This—under a patent of Sir C. Bright, No. 466, A.D. 1862—is a mixture of mineral pitch, tar, and silica. It was applied as a protection against the oxidation of the iron sheathing wires in sea water, galvanising having proved an insufficient safeguard. The silica (made from calcined flints) was incorporated in this composition for the purpose of evading the ravages of the teredo by damaging its boring tool, which object it was found to accomplish most successfully. The method of application of this compound to the sheathing wires of the cable also formed a feature in the same patent, and though now quite universal, was a novelty at the time. In it the compound is applied hot over the cable by means of an elevator driven from the sheathing (or "closing") machine, causing the "laying up" of the sheathing wires, &c., and the application of the compound to be performed at one operation. Moreover, as the supply of compound was arrested simultaneously and automatically on the "closing" machine being stopped (for putting in a fresh bobbin of iron wire, say) no damage could be caused to the insulator, as would otherwise occur by the hot compound continuing to flow over one part of the cable. The core (275 lbs. of G.P. per N.M.) was manufactured at the Gutta-percha Company's works, Wharf-road, and this was armoured at Messrs. Henley's works, that firm having obtained the contract for the same. In the manufacture of this cable the core was for the first time tested under hydraulic pressure with a view to the exposure of any incipient faults in the insulation due to air-holes, and so forth. This plan has since formed a part of the system of Messrs. Siemens Bros. Cable Works. In practice it is found, however, that besides being exceedingly expensive, the pressure tends sometimes to "mask" factory faults, as well as to divulge them. In the discussion on Mr. Walker's paper, Colonel Wells expressed his preference for land over submarine cables. Mr. Walker and others appear to have arrived at the same conclusion. I do not know whether those gentlemen are aware of the fact but, as long ago as 1866, this question of the relative merits of an aerial land line through a desert country, as against a submarine cable laid in shallow water along a favourable coast with an excellent bottom, was pretty well thrashed out by many able authorities, in the course of the discussion on a paper read at the Institution of Civil Engineers, on "The Telegraph to India," by Sir Charles

Tilston Bright, C.E., M.P. In the course of this discussion, a consensus of opinion was arrived at very much in favour of a submarine cable, notwithstanding the enormous difference in cost of the two. This view (shared in by Sir Patrick Stewart and Sir John Bateman Champain) was, moreover, borne out by facts, for the Persian Gulf cable has been remarkably free from interruption. One speaker referred to the risk of interruption to a submarine cable. Surely it is acknowledged by now that this is infinitesimal, compared with the same risk in the case of an aerial line, running across a desert country, in a tropical climate, with heavy rainfalls.

APPLIED ART SECTION.

Tuesday, Feb. 13, 1894; JOSEPH PENNELL in the chair.

The paper read was—

MODERN DEVELOPMENT OF ILLUSTRATED JOURNALISM.

BY HORACE TOWNSEND.

I believe it is a habit which has well-nigh crystallised into a tradition, for the speaker on such an occasion as this to preface his remarks with some apologetic references to his own incapacity for the due discharge of the task which lies before him. To-night I shall, in the familiar formula, "take such remarks as read," and premising that you are as well acquainted as myself with the reasons which tend to accentuate my own unworthiness, will waste no time in such preliminary flourishes, but as the late Mr. Ducrow would say, "cut the cackle" of self-depreciation, and "come at once to the 'osses" of my evening's subject. I desire, initially, to impress upon you that in dealing with that subject, I propose to confine myself as closely as may be to the developments which are going on around us in illustrated daily journalism, and to deal, not at all or only by way of example, with magazine and book illustration. The latter subject, indeed, has been so exhaustively and ably treated by—amongst others—your own secretary, Sir H. Trueman Wood, that for some time to come the last word on the subject has been said; while to enter into the domain of magazine illustration would lead me so far afield that I fear I could with difficulty return in reasonable time to the matter I have more immediately in hand. By confining myself, too, to the modern developments of illustrated journalism, I can, with the better grace, omit that historical

argument which, in its very nature, is so apt to exercise a soporific influence upon an audience and to expose the lecturer to the danger of being summarily condemned as that most dangerous pest of society, the bore.

Engraving, and I use the term in its widest significance, and embracing therein all photographic reproductive processes whatsoever, may be roughly divided into two main divisions, into one of which every plate and block, from which an impression is taken upon paper, naturally falls. The first of these is "relief" engraving, so called from the fact that the lines, by means of which the picture is produced, project in relief from the block, whether that block be of wood, metal, or even of stone. In the second, which is termed for want of a clearly definitive English expression, "intaglio" engraving, the lines are on the contrary, sunk below the surface of the plate. To obtain an impression from the relief block, all that is necessary is to prepare the latter by passing thereover a roller charged with printing ink. This adheres to the raised portions, which subsequently become the lines of the print, and leaves untouched the sunken surfaces which are to represent the white spaces. When, therefore, a sheet of paper is placed on the top of the block and pressure applied thereto, it is the raised places only which transfer their inky coating to the surface of the paper. The principle of printing from an intaglio plate is diametrically opposed to this. Here the entire surface of the plate is, first of all, covered with the ink, this is then carefully wiped away from the surface or open spaces and left remaining only in the sunken lines and depressions. When paper is forcibly impressed upon this plate it takes up the ink from these latter alone, the main surface of the plate leaving no record.

As a matter of fact, a print from an engraving or intaglio process consists of a species of cast, as it were, the paper being forced into the lines, impressions from which are therefore raised above the main surface of the paper in the print. The reverse takes place in the case of a relief block, the lines of which are depressed below the surface of the paper.

Of relief printing, the most familiar example is the page of an ordinary book printed from type. Of intaglio printing, the most commonplace example is an ordinary visiting card.

I am particular, at the outset, to impress upon you these fundamental differences, as without a proper comprehension of the contra-

distinctive nature of these divisions of what we somewhat loosely term engraving, the difficulties which have beset the path of the newspaper illustrator would not easily be comprehended.

A newspaper, as I need hardly say, is printed from type, and type is, in its essence, a form of relief engraving. It becomes absolutely necessary, therefore, that pictures which have to be printed side by side with type should be engraved by the relief, and not by the intaglio process. This is a conclusion, the full bearing of which upon the subject does not appear, until it is pointed out that the most artistically satisfying, reproductive methods are to be found in the ranks of the intaglio processes.

Of relief engraving, the parent undoubtedly is xylography, or wood engraving. In regard to its claims to considerable antiquity I need not detain you, beyond mentioning that its practical popular extension, to any considerable extent, depended upon the invention of paper, for upon paper alone could any considerable number of impressions be taken. It is true the East has for centuries furnished us with fabrics of silk and other stuffs, the designs upon which were printed from wooden blocks, but this can hardly be called a reproductive process in the sense in which we are at present considering it. Thus, as the manufacture of paper practically dates from the first part of the 15th century, so about this time we come upon the earliest indications of successful wood-cutting.

The first xylographic specimen of which we have positive knowledge, dating from 1414, has been preserved for us in the museum at Brussels. I have promised to spare you any unnecessary historical divagations, but I should like to point out that the first important step forward taken by the art was in connection with what may not unfairly be called the earliest illustrated newspaper. This was the *Nuremberg Chronicle*, published in 1492, which contained something like two thousand engravings by Wolgemuth, the master of Albert Durer. In the blocks which illustrate the chronicle we find, for the first time, the employment of cross-hatching, a technical method by which tones of varying intensity are produced, which opened the eyes of contemporary artists to the inherent possibilities of the craft. But from the days of Wolgemuth, Durer, Cranach, Burgmair, and Aldegrever, names and a period upon which I should be delighted to dwell at length,

I must take a sudden swoop through the centuries until I arrive at our own generation. I am considering this evening more particularly the subject of illustrated daily journalism, and illustrative daily journalism came into real, breathing, palpitating existence only by the aid of the photographic camera.

Almost, if not literally, from the day of Daguerre, the problem of producing, by photographic methods, blocks or plates from which, by purely mechanical means, a number of impressions could be taken, has occupied the minds of experimentalists. They were led almost at once on to the right track by the experiments and discoveries made by Niepce, Mungo Ponton, Poitevin, and others, who discovered that various organic substances, such as gelatine, gum, albumen, and so forth, when mixed with a solution of bichromate of potash and various other salts of chromium, became curiously affected by the action of light. Though perfectly soluble under all conditions, without such admixture those portions of the bichromated gelatine, for instance, which were exposed for any time to the action of light, became absolutely insoluble in water. It was evident, therefore, that if a film of gelatine or albumen which had been rendered sensitive by bichromate of potash were to be exposed under a negative, those parts to which light could reach through the clearer portion of the negative would become insoluble, while those which were protected by the dense parts of the negative would still remain soluble. Thus, a film of gelatine, after exposure for a proper length of time under a negative, might be washed in warm water with the following result:—The high lights, which in the negative are dense, and therefore shield the film from the light, would be washed away, while the shadows which in the negative are clean glass, would remain unaffected by the action of the water. If a positive instead of a negative were superimposed the reverse would be the case, that is, the high lights would remain at the height of the normal surface of the gelatine, while the shadows would be hollowed out to a greater or less depth. Roughly speaking, it is by the first of these methods that relief blocks are obtained, while by the second, photographic intaglio plates are produced.

Simple, as starting from these premises, the problem may seem, as a matter of fact it bristled with technical difficulties, and though it was in 1839 that Mungo Ponton first published the fact of the sensitivity to light of

chromium salts, it is only within the last decade that relatively satisfactory results have been obtained from photographic plates and blocks. The great difficulty which had to be overcome was the production of what is known as half-tone. An ordinary line drawing in black and white could be easily reproduced in the form of a relief block or an etching. Thus a plate of zinc, in one of the forms of process etching most commonly in use, is covered with a bichromated film of albumen. On this a negative of the line drawing, which it is wished to reproduce, is superimposed, and the two are exposed to the action of light. The clear glass of the negative, which represents the black lines of the drawing, allows the light to freely penetrate to the film of albumen.

After a sufficient exposure the plate is washed, and by this means all that portion of the film which has not been acted upon by the light disappears. If these lines be now protected by a coating of some such substance as printer's ink and the plate immersed in a bath of acid the unprotected spaces will be eaten away, while the lines protected by their hardened film will remain untouched, and a relief block is by this means produced. If, however, it is desired to make a process block from a drawing in wash, or from a painting, there are only two ways in which it can be done. Either those parts which are to print black or grey may be sunk to various depths below the general surface, and some mechanical means taken by which they will hold the ink, which after being applied generally to the entire plate, is rubbed off carefully from the raised portions or lights, and an impression taken from the intaglio plate thus formed by the ordinary methods of copper-plate printing. This, under the most favourable circumstances, is a slow and expensive process, and cannot be worked in conjunction with ordinary printing. The desideratum, therefore, not only for newspaper illustrations, but for those of books and magazines, is a relief block which shall be able to print the graduated shadows, which are generally known as half-tones. As a matter of strict fact there is only one tone in any relief block, the half-tones or graduated shadows being produced by broken lines or dots of the absolute black, or at all events the single colour of the ink employed. The closer together these dots and dashes of black are placed, the darker will be the shade, while the further apart they are, the lighter will the resultant tone be. This is, in fact, true with

one exception, of every form of engraving, photographic or otherwise, as even the delicate gradations, and practically exact tonal values of the finest mezzotint are produced only by the relative closeness together or distances apart of the minute little bits with which the surface of the copper-plate is initially overlaid, and which are scraped away to form the high lights, and thinned down and made smaller and shallower by the scraping processes to form the intermediate tones.

The exception to which I refer is the photo-mechanical process known as the Woodbury-type, after its inventor, the late Slater B. Woodbury. Not to confuse you with unnecessary details, I may say that these processes consist in producing an intaglio in the ordinary way by the use of bichromated gelatine. The delicately shallow mould which is thus produced is filled with a thin ink lying more deeply in the shadows, and in the thinnest of possible films on the higher lights. When this ink is printed off on to the paper and allowed to dry, the darker shades are represented by a thicker and darker pigment, and a truly-toned picture is the result. In relief printing, half-tones must be reproduced by some sort of stipple or lines, or dots, as in the case of an engraving. The most ordinary process now in vogue to bring about this result, is the employing of a fine network of criss-cross lines which is interposed at some stage of the operation between the negative and the sensitised film. By these means the half-tones are broken up into a series of dots or lines which can be printed from after the manner of ordinary type.

Herr Meisenbach, in Munich, patented, in 1882, a variation on this process, which is thus described in his own specification:—"The transparent plate is hatched or stippled in parallel lines. A transparent positive is made of the object which it is desired to depict. The two plates are joined preferably face to face. From the combined plate a negative is photographed in the ordinary manner. In order to cross-hatch and break the lines of the shading, the hatched or stippled plate may be shifted once or more during the production of the said definite negative. This negative is transferred in the usual manner to form a typographic block."

The greater the fineness of this network the more perfectly illusory is the resultant half-toned plate, and I may add that this screen, as it is termed, is usually produced by making a photographic reduction of one which is already

ruled as finely as ordinary mechanical means will permit.

In order to reach the desirable end of breaking up the tones, other methods, as I have said, besides those of the Meisenbach screen, are used. Thus one of the chief American inventors in the photographic process field, Mr. Frederick Ives, of Philadelphia, some years ago patented the half-tone process, named after him, from which most artistically satisfactory results have been gained.

He used, I believed, a rubber pad on the surface, to which there were cut at right angles to each other minute V-shaped grooves, through whose agency the surface was thus converted into a series of tiny little combs. These are inked, not only on the points, but on the sides. From a gelatine relief, inked in the usual way, by exposing a bi-chromated film under a negative and then washing away the unhardened portions, a plaster of Paris reproduction was formed. Upon this was pressed the inked rubber pad, and the relief lines and surfaces were varyingly impressed with a series of inky dots which, owing to the expanding nature of the rubber, were larger where the pressure was greater owing to the relief being higher and smaller where the relief was lower, and so was either not reached by the little points at all, or did not flatten them out. The shadows, which were in relief, were thus rendered by a series of larger dots, while for the highest lights the white surface of the plaster was left intact. Of this dotted rendering of the relief a photograph was then taken, and the negative thus obtained was used to prepare a relief block by any one of the ordinary processes. From some points of view the result is preferable to that of a Meisenbach block, for what is termed a differentiated grain is offered to us in place of the unvarying and mechanical grain, which alone can be produced by the netted screen.

The superior artistic quality of a differentiated grain is due to the fact that the largest dots are confined to the heavier and the smallest to the lighter of the tones, a truer gradation in tint resulting.

I have dealt, I trust you will not think at an inordinate length, upon the principles of photographic process engraving and etching (whichever, of two terms, neither of them precisely correct, one may the more fitly employ), for two reasons. In the first place, I have always found the most surprisingly vague and hazy notions existing in the mind of otherwise well-informed people regarding the difference be-

tween an etching, a steel engraving, and a wood-cut, and as the limitations of illustrated journalism are dependent entirely upon these technical differences, it is as well at once to get the main principles plainly set out before us. I have confined myself to the photographic processes, because, as I have already hinted, the true history of illustrated journalism, as we understand it to-day, began to be written when Poitevin produced his first plate etched by the indirect agency of the photographic camera. It is interesting, maybe, to refer, as I myself have briefly done to the *Nuremberg Chronicle*, or, coming nearer home, to the occasional appearances in the earlier "Diurnals" and "Messengers" which took the place in some degree of our modern newspapers, of rude woodcuts which, in more or less haphazard fashion, aimed at ekeing out the scanty and brief written account of some happening of unusual importance. But it is interesting only as affording conclusive evidence of the inherent desire of people of all ages and of all centuries to stimulate their imagination by graphic representations of the persons or objects concerning whom they are reading.

It is not indeed of any much greater practical use to give more than a passing glance at the weekly story papers, which were the earliest examples in our own century of what may be called illustrated journalism. These had a part to play in its development and played it well. They taught the people to look for illustrations as a welcome addition to their current literature, and they assisted in the formation of a school of illustrators, who for many years led the van of progress in the world of black and white art. It was on the *London Journal*, for instance, if I remember the name aright, that Sir John Gilbert first manifested those extraordinary powers of facile draughtsmanship and rapid execution which, had he begun his artistic career in the nineties, would have made him probably an ideal daily newspaper illustrator.

Haste was a main factor in the carrying out of the work, both literary and artistic, on these periodicals. It is a tradition indeed, that just as a printer's devil was wont to sit waiting in the hall of the author while the latter scribbled the concluding lines of his week's instalment of the current "to-be-continued-in-our-next" narrative, so the lad from the engraver's would wait upon Mr. Gilbert with the wooden block, on whose surface the rapid pencil of the illustrator was to sketch the

lovely form of the heroine in some moment of poignant distress, with instructions from his master not to leave the house until the drawing was made. This haste and procrastination sometimes led to consequences which might have been disastrous had the readers of the journal been more exacting or more gifted with artistic perspicuity, for the artist would shirk the onerous task of reading the manuscript which he was illustrating, and making a sketch entirely "out of his own head," as the children say, would depict his hero and his heroine under circumstances which, though doubtless picturesque, had not unfortunately the faintest resemblance to any of those described by the unhappy author. But this rapid, if perfunctory, method, of working led to a corresponding facility and speed of execution in the case of the wood engraver, and so prepared the way for the rapidity of execution which was necessary when the weekly papers, and notably the *Illustrated London News*, which professed to give every week pictures of current events, came into existence. As time went on, and as the *Illustrated* waxed in importance and was hard pushed at one time or another by its more or less successful rivals, this rapidity of production became of the utmost importance. The appetite of the public for illustrations of current events which should appear in the pages of the weekly papers within a few days of their happening at the farthest, grew with what it fed upon. It was no longer possible either for pictures to be prepared beforehand bearing only a remote and conventional resemblance to the actuality of the subject they professed to illustrate. They had to be drawn from actual sketches taken on the spot by "Our Special Artist."

Now, as wood engraving is a slow and laborious process at the best, and as the blocks required to satisfy the public taste had to be greatly increased in size, not a little ingenuity was necessary in order to overcome what were apparently the mechanical impossibilities of the task. The means finally hit upon was an ingenious one, and one which is not only in vogue to-day, but which were it not for its exceeding expense might have perhaps prevented the daily newspaper illustrator of to-day from his entire dependence upon the photographic processes, and thus doubtless have hindered the extraordinary developments in the last-named field. The wood block on which the picture was drawn was formed of a multiplicity of small blocks carefully fitted together and bolted firmly up so as to form

a homogeneous whole. On this surface the design was drawn, the bolts and screws connecting the parts were taken out, and one portion of the subdivided picture, which thus resembled a child's puzzle-block picture, was given to each engraver, who set to work on his particular little square with all speed. When each had finished his work, the blocks were once more screwed together and a large wood-cut was thus produced in a twentieth or thirtieth part of the time in which it could have been accomplished by the ordinary method.

Upon the extraordinary success, artistically and otherwise, of the *Illustrated London News* and its chief rival, the *Graphic*, I need not, I am sure, in this room expatiate at any great length. Enterprise and mechanical skill were combined to produce two publications, which in their own particular field pointed out to the whole world the way to follow.

So marked indeed was this success that I have not the least doubt that for several years it retarded that very development of which I am here to-night to speak. Paradoxical as this may seem, the paradox upon a moment's reflection disappears. So excellent, from a popular point of view, was the outcome of the lucky combination of enthusiastic artists such as Herkomer, Fildes, Small, of half a dozen others of skilful wood engravers, whose names, however, were I to mention them, would probably sound but strange in your ears, and of energetic publishers, such as the elder Ingram, of the *Illustrated London News*, and the elder Thomas, of the *Graphic*, that those who perhaps foresaw a future in which there should be laid upon each morning's breakfast table a copy of a daily paper in which the pencil of the draughtsman should be almost as prominent as the pen of the writer, were prevented from taking any immediate steps in that direction by the inevitable and deterring reflection that they would bring themselves into direct competition with these well established purveyors to the public taste for popular illustration.

The very nature of the case was such that to the meaneast capacity (and sometimes the enterprising journalist's ratiocinative faculties are at least of average quality) it was apparent that the quick printing, the inferior paper, the necessity for almost instantaneous output which form an integral part of a daily journal, would inevitably stand in the way of any real artistic rivalry with the weekly illustrated papers. Comparatively speedy as the mechanical processes of the latter had become, they were all

too slow to render in any way possible their assimilation by the daily papers. Perhaps, too, our innate English conservatism, which is always inclined in art and business as well as in politics to let well enough alone, had not a little to do with this attitude. Let the weekly, said the daily journalists then, as a large majority of them say to-day, supply the illustrations of current events and stimulate to a greater degree than we can the imaginations of their readers. They are first in the field and let them hold it. It is our province to supply the news at all events the nearest approach to it which we can encompass, and let them supply the pictures.

This attitude was at once the cause and effect of the slow progress of photographic process work in this country. There was for many years no temptation to the process engraver to produce anything but the cheapest work, and the cheapest, as we all know, is, has been, and always will be the nastiest. For their best effects the great weeklies were perfectly content to remain steadfast to the wood engraver. The latter could at least, by the method to which I have referred, produce his blocks within as short a space of time as the needs of weekly publication rendered necessary, and if they cost a little more than others, why, the proprietors were making at least living profit, and what did it matter?

But this attitude could not for long be maintained. The happy results which attended the unremitting efforts of Continental and Transatlantic process workers began to attract the attention of the proprietors of English illustrated papers, until slowly, but surely, the process block began to oust the engraved wood block from its position in the pages of the weeklies. At first, indeed, the reaction from the primary indifference was as all reactions are, excessive, and the cry went up that the occupation of the wood engraver was gone. So far from this, we see to-day that the very growth of process work has elevated the art of the wood engraver; and though the weaklings and useless have been killed off, the masters have received no such recognition, pecuniary or otherwise, since the modern school of the art was almost created by Berwick. Firm as is the belief I hold in the almost unlimited possibilities of photographic process, I should be sorry to think that its growth meant the extinguishing of the radiant light of one of the most glorious of the reproductive arts. But the daily papers were slow

to grasp the opportunity, nor yet have they made up their minds to give more than a tentative shake to the tree which, in another country, has been found to bear such golden fruit. A few outline portraits, poor alike in conception and execution, and which are rendered still poorer by incompetent printing, and an occasional architectural sketch, mark almost the furthest point to which the afternoon dailies have advanced. The morning papers have not got further than abortive attempts to reproduce a coarsely-drawn map or two, without which the article would be otherwise wholly incomprehensible. I am not, of course, forgetting the *Daily Graphic*, to which I wish to take this opportunity of expressing my sentiments of respect and admiration as of a voice that is crying in the wilderness. But I cannot help looking upon it rather as an illustrated weekly which happens to be issued every day, than as a daily paper which is illustrated. That a daily illustrated paper, however, which hardly comes into direct competition so far as its news and editorial columns go, with the older established dailies, should yet have, within a few short years, spelt the word success, is proof enough, were none other at hand, of the popular demand for a graphic as well as a scriptural record of the passing events of the day.

But apart from the *Daily Graphic*, the developments in illustrated daily journalism, so far, at least, as this country is concerned, end as they almost began, with the trivial attempts to which I have referred on the part of one or two afternoon newspapers.

Some 3,000 miles away, however, in the United States of America, a very different state of things prevails. That daily journalism in America should have made advances, coy at first, but later on, more passionate, to the muse of illustration—if such a one there be—is due, in my estimation, to no extraneous or easily-definable cause, but to the entirely different position which journalism holds in that country compared to this. The American newspaper stands to a majority of its readers in the place of literature in general. But this, I think, is not because the readers have no taste in themselves for literature, but because the newspaper endeavours, as nearly as may be, to be in itself a compendium of literature. It is a sort of octopus, whose long and ever-active arms clutch from every quarter of the literary and journalistic field, and convey to the main body, there to be digested, whatever

they may find of energy and enterprise. Let this voracious creature find that there is a demand among the people for serial fiction—let me say for example's sake—which is being supplied by some publication specially devoted to this field, and one of its tentacles immediately becomes active, and adds fiction to the main body. Are certain journals supporting existence by catering to those classes which are interested in sport, or in music, or in the drama, or in art? Immediately the daily adds departments of sport, music, and so forth, which, owing to the numerous capital at their command, are even more efficiently carried out than they would be in the specialists' hands. It was, in my opinion, the striking advances in the art of illustration made by the American magazines, advances which form almost a commonplace of comment in Europe as well as in America, that led the newspaper proprietors in the same direction.

At first, the steps they took were halting and uncertain. Years ago a daily afternoon paper was started, and for some years led a precarious existence, which depended almost entirely upon its illustrations for its power of collecting pennies from the pockets of its clients. It borrowed its title from the London *Graphic*, but it was about at that point that its obligations ceased. It trusted at first to photolithography, and later on, I believe, to photozincography, as it is barbarously called, for the production of its illustrations. It could only be printed therefore in a very cumbrous sort of fashion; and although at first its very novelty gave it a certain vogue, it soon lapsed into a very second- or third-rate affair. Doubtless, however, it did some pioneer work. At all events it showed that there was a possibility of giving the news with pencil as well as pen, and sowed certain seeds of suggestion, the ripened fruit of accomplishment springing from which was later to be reaped by its morning contemporaries.

Tentative at first, and not very promising, were the illustrative experiments made by the New York dailies. They were confined to the simple outline portraits and sketches which it was then possible for photographic process to produce for the needs of rotary printing. I may be pardoned if I digress here for one brief moment to point out that the ideal method of printing, so as to gain the most satisfactory results, either from type or engraved blocks, is the old-fashioned hand-press. Next to this comes flat-printing by machinery, in which the sheet of paper is automatically pressed down

upon the body of type which lies in a horizontal position. The daily newspaper, however, with its circulation of hundreds of thousands, must be printed on what is termed the rotary press. The actual type in fact, which is set up by the compositors, is not printed from at all. Instead, a sort of mould of it is taken, in moist paper, which is subsequently so dried and hardened that when it is bent into a semi-circular form a cast can be taken from it in type metal. Two of these casts put together then form a cylinder which, when placed upon an axle, inked and revolved at a high rate of speed, prints upon a sheet of paper which is made to travel beneath it many thousands of impressions per hour. It was the practical difficulties connected with this rapid form of printing which caused newspaper illustration to be looked at askance for many years. It was not indeed until the *New York Herald*, with its great circulation and the almost unlimited capital which was behind it, took the matter up and resolved to enter seriously into competition with the publications which relied upon their illustrations alone, that any marked developments began to show themselves. These followed each other, however, with extraordinary rapidity. They all had been theoretically possible, and it only required the nicest mechanical adjustment to turn them into actual facts. Process work under the kindly stimulus of the magazines such as the *Century* and *Harper's*, had been making gigantic strides. In line work the reproduction of the finest lines and the most intricate and closest of cross-hatching and shading had become not only possible, but easy, while the half-tone processes had rendered the exact simulation of wash drawings an everyday affair. The necessary element of speed, too, was not forgotten, and carefully finished blocks were turned out within the space of a few hours, which, not many years before, would have required almost as many days for their efficient production. The printer, too, kept pace, to some extent, with the process engraver. He very soon discovered that the finest of lines left its impress upon the papier-maché matrix as well as the coarsest, and that the stereotyped cylinder cast therefrom rendered it in the required relief with scrupulous fidelity. Even that mystery of mysteries, the overlay, was partially overcome, and yet, with all these advantages, newspaper illustration was at best a somewhat unsatisfactory performance. It had taken many years—more than a lifetime, in fact—to so perfect the news-gathering system of the

American newspaper that it should work smoothly without friction and as one harmonious whole. It was not to be wondered at therefore that there was more promise than performance in the early attempts in this direction, even of the greatest of the daily journals. Artists were slow at first to understand that, just as a newspaper writer has to eschew certain literary graces and appeal forcibly and directly to his audience, so the newspaper illustrator has to lay aside some of his pet conventionalities, admirable as they might be elsewhere, of artistic expression. Process workers hesitated at throwing overboard traditions and methods which, though recently acquired, were none the less deep-rooted. Plates which should have reached the composing-room at one hour, straggled in during the course of the next, when, owing to the exigencies of the "make-up," they might just as well not have made their appearance at all. It took but a very short time for the proprietor of the *New York Herald* to see that either a radical change was necessary, or that the task of illustration had better be left to the weekly and the monthly publications.

He decided upon the former course, and made at once the illustrator and the engraver an integral part of the general machinery of his newspaper office. His example was to a certain extent followed by others, and then, and not until then, newspaper illustration in America took the enormous stride forward which tends to give promise even now that at no very distant date the daily paper will take the place in the affections of the picture-loving people, not only of the weekly journal, but even of the monthly magazine. A staff of illustrators work in the *Herald's* new building side by side with the staff of reporters, and while the latter are employed in scribbling off their copy, the former just as quickly sketch the main incidents of the event which is being described. While the reporter's copy goes into one part of the building to be set up in type by the compositor, the illustrator's drawing goes into another department to be photographed and engraved, without the loss of one second by the process workers. In like manner, just as carefully collected, news memoranda are preserved which will be useful should reference be made in the course of an article, or a news dispatch to some noted personage or famous place, so portraits and views are collected with unwearying diligence and care, fully filed away for the artist's refer-

ence upon the instant of necessity. Again, just as from time to time it has secured the services of some prominent or literary man to add some special dainty to the literary fare set before its readers, so the *Herald* is wont, as occasion may arise, to supply them with *fac-similes* of the artistic impressions of painters and draughtsmen of world-wide reputation. That a journalistic departure from the beaten track attended with such difficulties, mechanical and otherwise, should have been marked by an immediate degree of success is little short of surprising; that perfection should not at once have been attained is not to be wondered at.

How far the Americans have advanced in the printing of black and white drawings is sufficiently evidenced by the exhibits I am enabled, by the courtesy of the *Herald's* proprietor, to show to you to-night. You will see there the original sketch drawn often late at night, the process block made therefrom in the course of an hour or two, and the final result as it appeared in the morning's paper, and when I add that these are all printed from a rotary press at a speed of 96,000 copies per hour, I am sure you will admit that the result comes little short of miraculous. But the *Herald* was not to stop short at this point. Indeed, in the lexicon of the American journalist newspaper proprietor there is no such word as stop.

For the past decade the problem of colour-printing, otherwise than by lithography, has monopolised the attention of process workers in Paris, Vienna, New York, and in one case at least, in London. Without attempting to discuss the matter from the Empyrean heights of abstract art, I may, perhaps, be permitted to take for granted that, in popular estimation, a coloured picture is more attractive than one in simple black and white, for it leaves so much less to the imagination a function in which the average man is woefully deficient. Starting on this hypothesis it was evident that a process which would admit of the printing of a block in several colours conjointly with type, would be of enormous commercial value. The problem of intaglio colour production by photographic process had been triumphantly solved by Goupil, of Paris, who, however, employed the most careful of hand printing to attain his results, and who after all rivalled and did not excell the results produced in our own country a century ago by that school of mezzotint engravers whose artistic value we are only today realising. It is,

indeed, the printer rather than the process maker who has retarded the development of a relief colour printing, for it is clear to those who have the most elementary knowledge of the theory of lithographic printing, wherein a multiplicity of shades of colour are produced by the superposition of the primary and secondary colours, that a series of relief plates to serve the purposes of the various tint stones of the lithographer could be easily prepared. As a matter of fact, this has long been possible, and Mr. Hare, of our own city, to-day turns out process blocks for relief colour-printing, by means of which the most delicate gradations may be employed. A machine for printing these at a high rate of speed was, however, the desideratum. At first, the nearest approach to this was a press which printed colours in mosaic only. That is, each tint had a separate block, and no attempt was made to secure effects by gradation, or by the printing of one colour over another. Very charming effects, as the French have shown us, can be produced in this manner, but it yet stopped short of what was needed, especially as the process was a comparatively slow one. Then the proprietor of the *Petit Journal* invented the quick press which bears his name, and which is, in this country, used by the proprietors of *The Million*. In America, as the *New York Herald* coloured supplements will show you, an even closer approach to complete success has been made. These pages are printed on a press of the "Huber" pattern, which prints at a high rate of speed, and gives two colours at one feeding. Within a week or two, however, the "New Hoe" press which has taken many months to build, will be in running order. This will produce much more elaborate work, printing eight pages in four colours from a continuous roll of paper at a speed of many thousands per hour. Should it indeed do nearly all that is confidently claimed for it by its builders, it will almost revolutionise the art of colour printing from a rotary press.

I should not, however, like to say that the problem of colour printing will be solved, even when a press, which will print its 80 or 90 copies an hour, is built, and is found to work with consistent exactitude. So far, we are all, artistically speaking, groping, more or less, in the dark, and in some directions, at all events, the popular work of the day is hopelessly away from the proper track. To take an ordinary wood-engraving or process-block, and smear a lot of colour over sundry portions, is not the way to produce a colour print, though, in some

quarters—which I need not particularise—this fallacy seems to have gained ground. The machines and the mechanical executants may be as perfect as in this imperfect world of ours is possible, but the right material to work upon must be given them at the start, or the results will never be more than contemptible. That it is comparatively easy to produce an exact *fac-simile*, of a water-colour sketch, provided certain limitations have been frankly recognised by the original artist, some of the exhibits which I show to-night amply prove; and so it comes to this, that it is to the artist, rather than to the printer or the process maker, that we have to look for improvement.

Centuries ago, half of the problem was solved for us by the Japanese, and I only wish it were possible to show you to-night some of those exquisite examples, informed from start to finish with creative beauty, and yet subservient to the truest principles of reproductive art, which are at present being exhibited here in London in a well known art gallery.

Much of their finest effect is due, of course, to the fact that the touch of the artist has been present at every stage of their production, and a major portion of the beauty therefore we can never, so long as the world shall roll, hope to rival by mechanical means. But the underlying principles which are based on their instructive appreciation of the balance of tones and on their masterly use of broad colour effects, to which delicacy is imparted by subtle though simple gradation, may with advantage be studied by the colour draughtsman for process reproduction of to-day. Finally, the limitations of the process must be frankly recognised and borne in mind from the first moment that the artist lays brush to paper, and it will then be found, as in the case, for instance, of such other branches of art as stained glass work and mosaic, that these very limitations may, instead of curses, prove blessings, and perhaps the chiefest of artistic glories.

But I can hear you asking yourselves, after with such exemplary patience you have followed me thus far on my devious way: "What on earth is it to us how well a paper published three thousand miles away is illustrated?" Well, like Mr. Bunsby's remarks, the bearing of my reference to the *New York Herald* lies in its application. If these things can be done in the green tree of American journalism, why should they not be done as well or better under the more matured foliage of the English journalistic arbour? Why

should we lag so far behind America in this regard?

That the people want pictures is evidenced, if by nothing else, by the almost phenomenal success of those weekly journals which rely for their patronage almost entirely upon their pictures, and I hope I am not indiscreet in venturing the opinion that the weekly editions of the afternoon papers which are now coquetting with illustration, wherein are gathered together all the illustrations of the weeks' daily issues and others in addition, return to their proprietors not the least considerable portion of their profits. Where does the trouble lie then? It is certainly not the lack of artists who can draw in black and white illustrations fitted for reproduction in a daily newspaper, for the examples which you see here give evidence that no special *technique* is demanded. The man who can draw for a monthly or a weekly can draw for a daily paper; and that we do not lack talent of this nature, the pages of *Sketch*, *The Butterfly*, or *Pick-me-Up* denote. Does the fault lie with the engraver? Hardly. The pages of that latest comer of artistic monthlies, the *Studio*, gives evidence that blocks can be produced right here in London, which will compare with any that have been seen in the pages of the *Century* or *Harper's*; while the *Daily Graphic*, again, has shown us that, with proper appliances, rapidity of action can be attained without the sacrifice of artistic quality.

The printer is, of course, a stumbling-block of a sort, for none but those who have suffered from him can appreciate the general incompetence and crassly conservative immobility of the English master printer.

The trouble lies nearer the fountain head. We want enterprise among the proprietors, and we want more than that; we want a more serious view to be taken of the whole subject of journalistic illustration; and here I include in the term the weekly as well as daily papers. It must be recognised—as it is in New York—that the art-editor should possess the same attributes, and others, in addition, as the news editor. That he should be as practically acquainted with the mechanical processes he depends upon, as his colleague is with the methods by which news is acquired. Without this, either of them would be at the mercy of their subordinates. He must know his artists, and their several capacities, as the managing editor knows his reporters and his editorial writers. He must have, too, just as keen a sense of the value of

news, for this is an element which should as surely enter into the illustrations as into the article of a newspaper. His artistic faculty I take for granted. Rather a large order, you will say, in the slang phrase of the day. It is an order which has been filled most satisfactorily across the Atlantic and in at least one instance on this side also. May be, but not too large.

But let not the last words of what I fear has been but a rambling discourse smack of pessimism. If I have taken a gloomier view of our prospects than the circumstances warrant, I shall be only too glad to have my errors pointed out to me, as I hope they will be by those who follow me. But in any case I shall comfort myself with the belief that we are a common-sense people who are not too proud to learn, and the less so if the lesson is to be taught by those who are akin to us in blood as in language. It is possible that before the end of the next century the genius of the age will express itself, not as in our century, through literature, but through painting, and the painter of the future will appeal not, as in the past centuries of artistic glory, to the single patron, but to the unnumbered millions of his fellow people, and he will do this only by means of that perfection of the arts of reproduction to which I confidently look forward.

It only remains for me now to thank the authorities of the South Kensington Museum for an important exhibit of artists' drawings and blocks, Mr. James Gordon Bennett for the interesting exhibit of the *Herald's* work in black and white as well as in colour he has enabled me to show you. Mr. Joseph Pennell for the very complete and artistic collection, not only of his own admirable work, but of that of the leading illustrators of our day which hangs on by left, Mr. Carmichael Thomas, of the *Daily Graphic*, and the proprietors of *The Million* for examples of the illustrative work of those papers; and Messrs. Frederick Ives and Hare & Son for their interesting exhibits of process work of every variety.

DISCUSSION.

Mr. CARMICHAEL THOMAS did not know why Mr. Townsend said the *Daily Graphic* reminded him of the weekly edition published daily. He did not understand what the public could want more than the events of each day illustrated next morning, which was generally done. Of course, if an event happened a long way off, it was not possible. Looking at the illustrations of the *New York Herald*,

he should fancy that most of them were done some days or weeks beforehand.

Mr. E. BALE, R.I., said his only experience with the illustrated press related to publications which allowed of a little longer time than a daily paper; but he was much interested in the most recent developments of colour printing, and should have been glad to hear more of how that was accomplished in connection with the daily press. One element of success in colour printing was that one colour should be allowed to dry before another was applied. A most interesting process, from a scientific point of view, was just being developed for book illustration, which was an application of half-tone process blocks, three colours being used, and the artist could scarcely be said to have anything to do with it. The subjects he had seen were fruit, birds, &c., in which there was plenty of colour, and they were photographed almost automatically. A subject being placed in front of the camera, screens were introduced which only allowed certain rays to pass; all the blue rays having been thus photographed, another screen was used, and all the red rays photographed, and, lastly, in the same way, the yellow tints were obtained. Then process blocks were made, and by printing these one over the other, a result was obtained which was as near to a water-colour drawing as anything he had seen. The half-tone blocks were produced by a combination of crosslines and dots, but it was found that in printing the colours got mixed, and to overcome this defect a process had been patented under which the lines for one colour were all in one direction, and those for the others in other directions; so that the secondary and tertiary tints were obtained by the juxtaposition of the primary colours rather than by mixing them—in fact, they were mixed by the eye.

Mr. H. L. BRAEKSTAD said he knew that a similar process was being carried on in Germany, but the three colours were printed one on the top of the other immediately: first the yellow, then the red, and lastly, the blue.

The CHAIRMAN asked if the *New York Herald* coloured illustrations were printed in New York or in Paris, because he recognised several pictures as having come out first in French papers?

Mr. S. ADAMSON said the coloured supplement to the *New York Herald* on the wall was originally in the *Figaro Illustré*.

Mr. TOWNSEND said that this was hardly correct. The plates might have appeared in the *Figaro* subsequent to their appearance in New York. Some of the colour-blocks had been made in Paris by Goupil, but the printing, which was the more important, was all done in New York. He thought contemporary printing matter would be found on the back. Whether the blocks were made by French workmen in Paris, or by French workmen in New York,

seemed to him of little importance. If at present they could not get men in New York to do this work, yet when they had learned, he had no doubt American craftsmen, would do it as well as Frenchmen, if not better. He had been favoured with a report from the foreman of the *Herald's* process department, in which he said that the Hoe machine, when completed, would print in four colours at 5,000 to 10,000 per hour. The ordinary illustrations in the daily papers were printed at the rate of 96,000 an hour. The blocks were produced with great celerity, one instance being mentioned in which an artist reached the office at 12.15 a.m. with a sketch relating to a murder, and by 1.10 a.m. it was ready to go to press.

Mr. HARE said he had seen the process Mr. Bale referred to in America, and no doubt it was interesting from a scientific point of view, but he doubted whether it would be of much value for artistic purposes. He saw in the Chicago Exhibition some specimens by the side of the originals, and they were very unsatisfactory. The process seemed only suitable for subjects in strong primary colours such as Mr. Bale had mentioned. The same process was being worked in Vienna, and had the same limitations.

Mr. LEWIS F. DAY said he could not see anything decorative or ornamental in the illustrations which appeared in the daily papers. So far as art was concerned he thought them an unmitigated nuisance; but from a journalistic point of view, as helping to satisfy the public curiosity, it was a different matter. In that respect he preferred a photographic process block, because there was no doubt about its correctness; it was, as the French said, a document, and in that sense was satisfactory. The only thing of the kind in roughly printed journals which at all appealed to him were those mechanically produced by photography. He did not see that there was any scope at present for anything more than trade art in the daily journals, but the public seemed to call for illustration. It was a degradation to any artist to have to produce a sketch while the printer's devil was waiting.

Mr. S. ADAMSON thought it was a question whether the public were really gratified by coloured illustrations in newspapers. If an artist brought forward anything good the art editors always told him it was of no use, as the public did not want it. They knew that a newspaper was simply a speculation. In this country there were many artists who could produce such things, and there were the means of getting them reproduced, but the question was, did the public want them? Such a paper as *Gil Blas* would fall flat in England, while it paid in France.

Mr. GLEESON WHITE said his paper (*The Studio*) had no connection with daily journalism, but he was endeavouring to bring artists into touch with literature, and to show them how to learn the various technical requirements of printing.

Mr. HENRY BLACKBURN said he had come hoping to hear something of the modern developments of illustrated journalism, such, for instance, as illustration by telegraph. He found, perhaps, the best illustrated daily paper in England, one of its attractions being its literature and the way in which it was put together. But there was a great deal more to be done before the illustrated paper reached anything approaching perfection, though he doubted whether colour-printing would ever be called for in a daily paper, except for supplements. There was a great deal more to be done before the events of the day could be said to be illustrated pictorially.

Mr. FRANCIS COBB, referring to the photographic aspect of the paper, said the efforts of Ives, in this country, and of Lippmann, on the Continent, were as yet in their infancy, but he believed they would grow to healthy manhood, and some years hence they would be in a very different position. No one supposed that at present they were available for the purposes of daily journalism, but they were making rapid strides. He thought Mr. Day was rather hard on photography as being a mere mechanical process, and there again very great progress had been made recently. There was an exhibition now on view at the Camera Club of photographs by Mr. Burchett, in which he had succeeded in producing results never before attained, and those who thought photography was a merely mechanical art could not do better than go and see them. He had succeeded very well in bringing natural clouds into his pictures, instead of transferring them from another plate. He would also call attention to the recent Salon exhibition in Piccadilly, which showed that a new line had been struck out altogether.

Mr. DAY said he had no intention of being hard on photography; he merely referred to the production of a picture by photography, without the intervention of a draughtsman.

The CHAIRMAN said he agreed with many points in the paper, but with many he did not. Both the reader of the paper and Mr. Day had referred to the rapid work of men like Sir John Gilbert, but if they would examine it carefully, they would find it was as good as any work almost in the world, and there was this quality about it, that it would print. On the wall there was a drawing which he was sure even Mr. Day would appreciate, by Mr. Phil May, which was as good art as anything which could be done, and it could be printed perfectly, even on cheap paper and with nasty ink; it would print no better with fine press-work. There were some young men, working on the *Daily Graphic*, the *Westminster Gazette*, and the *Pall Mall Budget*, who were doing excellent work for rapid printing. He thought Mr. Day was absolutely wrong in his theories. He and his friends were very fond of referring to Albert

Dürer, but if ever there was a man who worked down to his public, and went in for cheap printing, it was Albert Dürer, and he sent his wife out on market days to peddle his prints about at the lowest possible prices. All this is recorded in his literary remains, translated by Mr. W. M. Conway, or so much of them as would bear translation. He did not agree with Mr. Adamson that *Gil Blas* would fail in England; it would have a "bigger success than the *Daily Telegraph*, but it could not be published here, and even in Paris it was sometimes suppressed, and he believed it was mainly bought for the sake of the text, not for the illustrations. The reason why good artists would not work for the daily press, was not because their sketches would not print; they could soon learn to work down, or up, to the needs of the daily paper, but the proprietors would not or could not afford to pay the prices given by the weeklies on monthlies. An artist who drew for a daily paper, was expected to accept a remuneration about equal to that of a penny-a-liner. Of course, work which would print well in a magazine would not print well in a daily paper, unless specially prepared; but, as to photographs, he never saw one that came out anything but a black mess; in a daily they were only used because they were cheap, and the public were ignorant and guillible enough to accept them. He did not think the public knew or cared anything about pictures; the majority were densely ignorant, if not, they would never buy the rubbish they did, when they could get really good work. It was quite a mistake to introduce the Japanese artist as one who had to work up to the process of printing. The engravers who produced those prints were some of the most clever people in the world, and the artist was his own printer. An edition was generally 30 or 50, sometimes 100; and, if you saw a dozen copies of the same subject, they were often coloured quite differently. As Mr. Hare said, when you came to analyse and simplify colour, though you might represent some natural objects, you could never get a delicate symphony in colour by mechanical means. Putting on colour was purely an individual matter, and no machine would ever be able to accomplish it successfully; nor would photography ever become a fine art. Mr. Townsend had been rather rough on England. The best work yet had been done in France, but England was now taking the lead. The first illustrated daily in the world was the *New York Daily Graphic*, but nearly all the illustrations were in lithography, and half the contents were stolen; but the best daily illustrated journalism was now to be found in the London *Daily Graphic*. As to getting things done quickly, he had been to a fire, and got a sketch in the paper the next morning without keeping it waiting long, but he would not say much for it from an artistic point of view. The Sunday editions of American papers were very much like a weekly journal, many of the artists being men who drew for the monthlies, and these illustrations were

very different from those which came out in the daily editions of the same paper. In the future he believed the weekly newspaper would disappear, and there would only be the dailies and monthlies, owing to the improvements in the printing process now being made; good wood engraving would be more used, though processes would also be largely employed.

Mr. TOWNSEND, in reply, assured Mr. Thomas that he had no intention of casting a slur on the *Daily Graphic*, but he thought the style of make-up, and the dissociation often of the pictures from the text they were related to, made it seem more like a weekly paper. He thought the daily illustration of current events had a much larger future before it, and that news interest in illustration was an element which required to be more fostered on both sides of the water. With regard to Kurtz colour process which Mr. Bale had described, Mr. F. Ives told him only the previous day that as early as 1884, he produced colour-blocks practically on the same method, with the lines running in three directions from the three primary colours, but the mechanical difficulty of getting precisely the same amount of ink, and the same consistency, would stand in the way of its success until much greater improvements were made in the mechanism for printing. He thought Mr. Adamson was wrong in saying the public did not want coloured illustrations. They wanted everything that was good. It was a great mistake to undervalue and despise the public. As the late Dion Boucicault once said to him, it was a fatal mistake to despise your public. There was a great deal too much of this, and there was no greater sinner than his friend, the Chairman, though he thought a great deal of it was merely superficial. He relied on the more cultured section of the public, and found it pay. Art editors seemed to know a great deal more about the public than the public did themselves; but they were all part of the public. He always felt that what interested him was sure to interest hundreds and thousands of others, who were brought up under similar conditions, and educated in the same way. He was sorry to say he knew nothing about illustration by electricity, or he would have dealt with it. He had a letter once from an ingenious gentleman, who said he had discovered such a method, but on going to see him he found that though it was perfectly successful it would take several weeks to work out the illustration when it was telegraphed, and as that did not seem of much practical use, he did not inquire further. Mr. Cobb's hope of seeing photography recognised as artistic, he did not think would ever be realised if he meant thereby a creative art, though he was convinced that in some hands it might be made an artistic reproductive process, and as such it was often undervalued. Some of Mr. Hollyer's reproduction of pictures almost had the dignity of creative works because they gave some-

thing which was not in the original picture. It was quite a mistake to suppose he intended to under-rate Mr. John Gilbert; on the contrary, he had borrowed from South Kensington one of his most beautiful drawings on wood, as a specimen of what such work should be; and he had pointed to him as the pioneer in journalistic illustration. He possessed marvellous facility, inexhaustible invention, and many other qualities which were not always recognised by the younger men. He did not mean to say that the deficiencies of printing prevented the best men drawing for newspapers. Some of the first artists drew for the *New York Herald*, and he had an idea that Mr. Pennell himself sometimes drew for the *Pall Mall*. He saw no reason why newspaper illustrations should not be artistic. Art could accommodate itself to any mode of expression; they might not have hit on the right mode yet, but they would in time. It was absurd to sneer at everything that was not perfect, or exactly in accordance with one's own predilections. The majority of the blocks he had shown were from the daily issues of the *New York Herald*, and they were all good; the coloured and half-toned blocks were usually reserved for the Sunday edition. Haste was only necessary for work purely illustrative of news. The best articles in a paper were not those written at 12 o'clock at night, and the same with illustrations; a picture made a week ahead was just as much pictorial journalism as an article written at leisure was daily journalism. His paper was intended to excite comment and criticism, and he was gratified that it had not altogether failed in its object.

The CHAIRMAN then proposed a vote of thanks to Mr. Townsend, which was carried unanimously, and the meeting adjourned.

ELEVENTH ORDINARY MEETING.

Wednesday, February 14, 1894; WILLIAM H. PREECE, C.B., F.R.S., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Barnes, Robert, Ormonde-house, 6, Clevedon-place, Brighton.

Harris, Robert, 50, Edith-road, West Kensington, W.
Matthews, Edward Eckstein, Ph.D., 18, Cranleigh-villas, Willesden-green, N.W.

Singleton, Charles James, 11, Cleveland-row, St. James's, S.W.

Smith, Willoughby Statham, 13, Courtfield-road, South Kensington, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Brown, Geo. Turville, 34, Great George-street, S.W.
Buchanan, James, 62, Dale-street, Tradeston, Glasgow.

McCarthy, William, 21, Great Elm-road, Bromley, Kent.

Morison, Bruce, 20, Clanricarde-gardens, W.

Neal, William Phené, Pinner's-hall, Old Broad-street, E.C.

Ross, William A., Belfast, Ireland.

The paper read was—

THE ST. PANCRAS ELECTRIC LIGHTING INSTALLATION.

BY PROFESSOR HENRY ROBINSON,
M. Inst. C.E.; M. Inst. E.E.

I have pleasure in complying with the request that I should describe at the Society of Arts the Electric Lighting Installation that I have carried out for the St. Pancras Vestry. I would state at the outset that St. Pancras was the first municipal authority to appreciate the importance of preserving the business of electricity supply in its own hands, inasmuch as in the year 1882 the Vestry Clerk, Mr. T. Eccleston Gibb (to whom is mainly due the successful action of the Vestry throughout), called the attention of the Vestry to schemes which had for their object the acquisition of electric lighting powers in the St. Pancras parish. In a report of his in that year he says: "A few years ago it was generally believed that electric lighting would not be made available for private houses and buildings for many years, although it might shortly be brought into use for public lighting. The invention of the incandescent lamp and other improvements have revolutionised the question of electric lighting, and while public authorities are in many cases giving up their experiments in street lighting, the several companies are extending their systems to buildings of all descriptions, and the time seems to have gone by when there is a willingness to undertake costly experiments in public lighting. It is probable now, that the electric lighting will be adopted in private buildings, before the local authorities adopt its use for street lighting, and therefore, the acquisition of the powers of monopolists are more likely to pass unnoticed, by the local authorities, and thus control over streets, &c., obtained similar to that exercised by water companies."

In connection with the views thus expressed by Mr. Gibb, as far back as 1882, I would quote the following from the inaugural address of the President of the Institution of Electrical Engineers in January last:—

"The financial success which has invariably attended the municipal electric enterprises has

relieved the rates at the expense of the wealthier classes in a perfectly legitimate manner; and the more electricity becomes one of the common necessities of life, the better it is that the supply should be in the hands of the community, and not in those of monopolists.

"A strange fact in connection with this subject is that the great majority of the Local Authorities should have waited until the passing of the Electric Lighting Act (1888) before applying for powers to supply electricity, for it must not be forgotten that their position was in no way affected by the alteration of the Electric Lighting Act (1882). The explanation must, perhaps, be looked for in the exaggerated expectations that were raised by the statements of company promoters in the year 1882, when the most reckless assertions were made as to the results to be obtained by establishing electric systems of distribution.

"The natural consequence was, that the inquiries set on foot by various local authorities in no way confirmed the sanguine estimates that had been dangled before the public to obtain its support; and the total failure of the electric light companies to carry out a single one of the orders and licenses obtained by them in the years 1883 and 1884, made the local authorities hesitate before they embarked the rate-payers' money in such precarious undertakings.

"Fortunately for the progress of our industry there were some corporations who could be convinced by the result of their inquiries, that the use of electric light would be very advantageous for a variety of purposes, and that the knowledge and ability of the electrical engineers had progressed sufficiently to make a profitable distribution of electricity from a generating centre possible.

"We have seen that their example has been largely followed, and there is every prospect of a continuous and ever increasing development of this branch of electrical engineering."

On the passing of the Electric Lighting Act 1882, I, in conjunction with Dr. Hopkinson, F.R.S., advised the Vestry to obtain a Provisional Order, and it was obtained in 1883. Owing chiefly to financial and other difficulties in connection with the Electric Lighting Companies, as before mentioned, public confidence was shaken, and the Order remained in abeyance. In 1888 various companies made applications for Provisional Orders by which the metropolis was proposed to be divided amongst them, but at the Board of Trade enquiry that was held in 1889, the St. Pancras Vestry succeeded in getting their district excluded from the operation of any company. I was thereupon instructed to prepare a scheme to serve, in the first instance, the south west, or Regent's-Park, division of the district, which formed the compulsory area under the

Order. In advising upon this, I kept in view the ultimate requirements of the other parts of the St. Pancras district, so that the first installation should form part of a comprehensive scheme. I decided upon adopting the continuous current system.*

The situation of the site that was originally proposed by the Vestry necessitated the employment of high tension with five transformer sub-stations to feed a network of low tension distributing mains. The ultimate acquisition by the Vestry of a more central site in Stanhope-street (consisting of twenty-one thousand square feet of freehold property, purchased for £10,000) enabled me to adopt the low tension direct supply system entirely for private lighting, and to have only one battery sub-station at the Cobden Statue, one thousand one hundred and forty yards from the central station. It was decided to work the public arc lamps by high tension continuous current independently of the private lamps.

The plant was designed at the outset to serve ten thousand incandescent lamps of sixteen candle power simultaneously in use, and ninety arc lamps of ten ampères each for public lighting.

I should mention that the action taken by the Vestry was not adopted without strong opposition being offered (which is, in fact, still continued), to the Vestry's undertaking this work. However, on January 1, 1890, authority was given by a large majority for the work to proceed. Having overcome opposition from within, a quite unexpected difficulty arose in consequence of uninvited advice and proposals being made from outside (not altogether of a disinterested character) which disturbed the minds of the Vestry.

On my advice Dr. Hopkinson and Mr. Preece were consulted, and it was a satisfaction to me that they entirely concurred in my proposals, and the execution of the works, which had thus been interrupted, was proceeded with.

The following is a description of the works:—The buildings consist of an engine-house 106 feet by 26 feet, a boiler-house 53 feet by 35 feet, coal store 43 feet by 11 feet, battery room 40 feet by 14 feet 6 inches, testing-room, office, stores, underground tank for condenser water containing 170,000 gallons, chimney 5 feet square inside and 90 feet high.

There are eleven engines and dynamos, which are erected on a concrete foundation

* Some data in regard to the various systems of distributing electrical energy I have recently had printed in pamphlet form, and they can be obtained of Messrs. Spon.

surrounded by sand to prevent vibration being communicated to the walls, and the floor is carried, independently of the engine foundation, by cantilevers from the walls. The engines are of the Willans type, and the dynamos are of the six-pole Kapp type (made by Messrs. Johnson & Phillips). Nine of these are wound for an output of 680 ampères at pressure varying from 112 to 130 volts. Three are capable of giving 145 volts with a small current for charging batteries at the sub-station, and can be worked self-exciting as simple shunt machines, or separately excited. They were tested with a load of 680 ampères at 118 volts, and the steam consumption was found to be 18.65 lbs. per electrical horse-power per hour, working condensing, and with the dynamo separately excited. The remaining two dynamos are wound for an output of 90 ampères at from 540 to 575 volts. They are separately excited at low tension, and are used for working 86 arc lamps in the streets, as well as for charging in series four sets of storage batteries of 60 cells each at the central station, which are capable of discharging 60 to 75 ampères. The trials of these two engines showed a consumption of 19.6 lbs. of steam per electrical horse-power per hour.

There are five Babcock & Wilcox boilers, each being 23 feet long and 5 feet wide between the walls, with one steam drum 3 feet 6 inches in diameter. Each boiler has a heating surface of 1,619 square feet and a grate area of 30 square feet, and is capable of evaporating over 5,000 lbs. of water per hour, the working pressure being 170 lbs. per square inch.

There are two 6-inch steam mains along the top of the boilers fed by separate outlets from each boiler and delivering into a 6-inch main (which extends the whole length of the engine-house) at three points. The mains are so arranged that only two engines are put out of use by the removal of any one pipe. The long pipes are made of wrought-iron, the short pipes and T-pieces of cast-iron, and the bends of copper. The main exhaust-pipe, under the engine-house floor, varies from 5 to 15 inches in diameter. The steam can be exhausted to the atmosphere, but under ordinary circumstances it passes into a jet condenser, which draws its water from the bottom of the underground tank. Two air-pumps, driven by a Willans compound-engine, discharge the hot water from the condenser into the top of the tank. A Körting ejector condenser is provided as a stand-by for heavy loads. From the top of the tank the

hot water is pumped by independent circulating pumps to a cooling apparatus, which is capable of dealing with a minimum of 10,000 gallons per hour. The cooling arrangements consist of a large surface of corrugated iron sheets, attached to framing placed round the chimney shaft, the water, after flowing over the corrugated surface, being collected beneath and returned to the bottom of the tank.

A dry air machine is provided for the purpose of delivering dry air into the street main culverts at the rate of 5,000 cubic feet of air per hour. The air has its dew point lowered to 40° Fahr.

The arc lamp-posts (86 in number, displacing 479 gas-lamps) are of the Brockie-Pell type, and are placed in the centre of the road, where this is admissible. In some places, however, they had to be placed on the pavements, as tramways prevented them from being in the middle of the roads. The first lamps that were erected (in Tottenham-court-road and Euston-road) are 25 feet from the ground to the centre of the globe, but those more recently put up, which are chiefly on the pavements, are 22 feet. They are fixed at distances varying from 160 to 245 feet apart, and are fed with a current of 10 ampères. Eleven lamps are worked in series near the central station, and ten in series at a distance. Nine arc lamps have more recently been put up in Park-street and supplied with current off the low tension mains.

The main switchboard is arranged on the three wire system. Each dynamo is provided with a double pole switch and copper coupling straps to connect the machine to the third wire and to different bars on the feeder-board on either side of the circuit. There is an ampère meter on each dynamo. One terminal of the dynamo switch is coupled by a strap to the third wire main, and the other terminal is coupled to a bar on the feeder board. There are four positive bars and four negative bars, and at full load one machine can be run on to each bar and worked at any pressure which may be necessary to serve the feeders which are switched on to it. Thus the dynamos may all be worked at different pressures to suit the demand in the districts which they serve. There are seven feeders, in addition to a direct supply on to the distributing mains, which are connected in a network throughout the district. The bars on the board may be connected directly in parallel or through resistance cells, which will each carry currents up to 180 am-

pères, offering a counter electromotive force of from 2 to $2\frac{3}{4}$ volts. By using these cells current can be supplied to the feeders at four or five different pressures from one dynamo which enables the dynamos connected to long feeders to help those serving short feeders, and further enables regulation over large areas when only one dynamo is at work on each side of the circuit.

There is an underground sub-station beneath the open space at the Cobden Statue, High-street, Camden-town, at a distance of 1,140 yards from the central station which contains two batteries of 58 cells each.

The mains are laid throughout on the "three wire system," the arterial mains being sufficient to supply 25,000 lamps of 16 candle-power in use simultaneously. The conductors are chiefly composed of bare copper strips $1\frac{1}{2}$ inches wide and $\frac{1}{2}$ inch thick, supported on edge in glazed porcelain insulators, which are carried on small cast-iron brackets built into the walls of the culverts. Some of the mains are cables laid in cast-iron pipes, and in the extensions now being carried out they are Siemens armoured cables.

The works originally authorised, I estimated would cost about £50,000, and this estimate was increased to about £52,000 when the Stanhope-street site was adopted. The actual cost of the works when completed was about £56,000, or within 8 per cent. of the estimate, which, I think it will be admitted, was satisfactory. During the execution of the works originally authorised by the Vestry, extensions were made by the Vestry which involved a considerable increase in the capital expenditure.

The works were so far completed as to enable public supply to be commenced on November 9, 1891, (or a year after laying the first stone). By the end of January, 1892, there were 6,500 incandescent lamps of 16 candle-power installed (or their equivalent), and at the end of 1892 there were 11,733, and at the end of 1893 there were 14,617 lamps installed, and many more contracted for, to come on shortly.

The current for ordinary supply is charged at 6d. per unit, but it is charged at only 3d. per unit for what is termed "day load," which might be defined as current supplied for motive-power and other purposes at times other than those of maximum demand.

The public lighting is at present charged for at the rate of 6d. per unit, which covers the entire cost of production as well as for carbons,

trimming, &c., together with all capital charges and maintenance, including lamp columns, lamps, street refuges, &c. The electricity department takes charge of all these matters, and the public lighting account is only debited with one item, "current used," at 6d. per unit. The cost of carbons and trimmings for the 95 public arc lights in 1893 was about £600.

Capital Expenditure to 31st December, 1892.

	£	s.	d.
Lands (part only utilised)	10,827	0	0
Buildings	7,653	17	1
Machinery and plant	24,378	17	8
Batteries at central station and sub-station at Cobden Statue	2,961	6	11
Mains, of which some are capable of carrying current for 25,000 lamps	33,787	15	3
Public lamps	6,723	8	4
Meters	1,556	3	9
Electrical instruments, &c.	284	16	3
Office, and other furniture, and fittings	186	7	4
Preliminary expenses	554	4	7
Total expenditure to 31st Dec., 1892	88,913	17	2

During the year 1893 a sum of about £10,000 was expended in extensions of public lighting, together with mains, meters, house connections, &c. A further increase of the generating plant at the central station has been rendered necessary, owing to the increasing demand for current. These works are now nearly completed, and consist of an extension of the central station buildings to receive three more engines and dynamos, three additional boilers, together with a second sub-station in Fitzroy-road, near Primrose-hill, 2,700 yards from the central station, containing two sets of batteries. These extensions will cost about £13,000.

The "fixed charges" in the shape of the permanent staff, &c., commenced in the middle of 1891, before the public supply of current began. Some of the working expenses of the Station during that year, and also in 1892, were incidental to a new undertaking. The following figures for those years, therefore, do not admit of being taken as any criterion of what the normal relation between receipts and expenses will be, but they are given as a matter of record. From the commencement of public supply in November, 1891, to the 31st December, 1892, there were 11,733 lamps of 16 candle-power, or their equivalent current, installed (including 11 motors = 36 horse-power, and 92 private arc lamps), of which 6,823 were in simultaneous

use. The number of units sold to the end of 1892 was 433,519. The amount charged for lighting the 86 public arc lamps (which were at work only part of the year) was £2,040, the current being charged at 6d. per unit. The total working expenses of all kinds from the commencement to the end of 1892 were £7,438. A sum of £408 was expended on the maintenance of plant. A capital sum of £4,119 was repaid, made up of £400 capital and £3,719 for interest on loans at $3\frac{1}{2}$ per cent. The number of tons of coal used to the end of 1892 was 2,728, and its cost was £2,828, the price of coal being from 20s. to 21s. 6d. per ton.

For the year 1893 the following are the figures:—

Number of 16 c.p. lamps, installed or equivalent current, including 19 motors, = 61 h.p. and 110 private arcs	14,617
Number of 16 c.p. lamps (or equivalent current) simultaneously in use	6,187
Number of units sold for private lighting ..	397,217
Number of units sold for public lighting ..	197,676
Total number of units sold	594,893
Receipts for private lighting	£9,546
Receipts for 93 public arc lamps, the current being charged at 6d. per unit	£4,941
Total receipts for current	£14,487
Working expenses	£7,033
Repayment of capital.....	£1,628 }
Interest on capital, at $3\frac{1}{2}$ per cent. £2,797 }	£4,425
Expended on maintenance	£1,402
Total for working expenses, repayment of capital, and maintenance	£12,860
Number of tons of coal used ..	3,180
Cost of coal (price about 17s. 9d. per ton)..	£3,008
*Cost of coal per unit sold	1'21d.
Cost of a unit sold if capital had not been repaid	3'4d.
Cost of a unit sold with capital repaid, and maintenance	5'18d.

The Table on page 251 may also be of interest.

The year 1893 was exceptionally free from fogs, and those which occurred were, I believe, chiefly on Sundays. This led to the receipts for current per lamps installed for that year being below what may be expected over an average number of years. In considering the foregoing Table, it should be remembered that the capital repaid is in respect of the cost of a site, the cost of mains, permanent charges, &c., for the supply of a far greater number of lights than those which were supplied during the year, so that, in

future years, the cost of production will diminish, inasmuch as the fixed charges and repayment of capital will be spread over a much larger output.

The question of the terms of repayment of the capital for electric lighting by municipal authorities is now receiving serious consideration, as affecting the price at which the public can be supplied with current. The matter has been dealt with by Mr. Gibb, and I refer to the views that he has lately brought before the London County Council, as I am of opinion they have an important bearing on the municipalisation of electric lighting. It has been sought to make the period for repayment of the loans dependent on the life of the machine or apparatus to which it applies, instead of for 42 years. A limit of 42 years was adopted by Parliament, instead of 21 years fixed upon in 1882, as it was found that the shorter period did not enable companies to recoup themselves for their outlay on the monopoly granted them. As it now stands, the ratepayers can only acquire the electric lighting undertakings of companies at the end of 42 years by purchase at their then value; whereas, if an authority extinguishes its capital in 42 years, the future ratepayers succeed to the undertaking without any payment whatever. The view the St. Pancras Vestry take is that the repayment of capital should be spread over a period of 42 years, and that renewals should be met out of profits supplemented, if need be, by a rate or loan, when the extent of the expenditure justifies it being spread over several rates, by which the present generation of ratepayers would be able to have the benefit of cheap electricity, which it could not otherwise have.

It is often stated that the cost of public lighting by electricity is greater than by gas. If the same standard of illumination had to be obtained by gas as by electricity the statement would not hold good. It is entirely a question of whether or no the standard of lighting does not require to be raised. I think it does. The present lighting of the thoroughfares in the metropolis is a reproach, and St. Pancras has led the way in reforming this. I am confident that at no distant date the present inefficient lighting of the streets will be looked back upon as comparable with the old oil lamps for which gas was substituted at a great increase in cost of public lighting.

Electricity economically produced by an authority will be available for the "masses," and not only for the "classes" as is often

* This was more than it should have been.

TABLE GIVING A RECORD OF THE VARIATIONS OF LOAD DURING THE YEAR, AS TAKEN FROM THE LOG AT THE STATION.

MAXIMUM LOADS OBSERVED AT REGENT'S-PARK STATION, 1893.			MAXIMUM LOADS OBSERVED DURING DECEMBER, 1893.			
Date.	Ampères.	Time.	Date.	Maximum Ampères.	Time.	Maximum Load.
January 3rd	1,570	4.15 p.m.	December—		P.M.	P.M.
	3,670	6.15 „	1st	2,950	7.45	4.30 to 8.0
	1,140	9.15 „	2nd	2,455	7.45	4.30 „ 10.0
February 28th	1,295	5.0 „	3rd	755	7.15	6.0 „ 10.0
	2,140	7.30 „	4th	2,310	7.45	4.30 „ 8.15
	1,010	9.45 „	5th	2,320	7.45	4.30 „ 9.0
March 28	900	6.45 „	6th	2,380	7.45	4.30 „ 9.0
	2,210	7.45 „	7th	1,970	7.45	4.30 „ 8.15
	1,065	10.15 „	8th	2,455	7.45	4.30 „ 8.30
April 24th	730	7.15 „	9th	2,555	7.45	4.30 „ 10.15
	2,305	8.0 „	10th	785	8.15	6.0 „ 10.0
	930	10.45 „	11th	2,540	5.45	4.30 „ 8.0
May 13th	1,090	7.45 „	12th	2,560	5.45	4.30 „ 8.15
	2,180	8.45 „	13th	2,870	7.45	4.30 „ 8.30
	1,225	11.15 „	14th	2,190	7.45	4.0 „ 8.30
June 24th	835	8.15 „	15th	2,560	5.15	4.0 „ 8.30
	2,010	9.15 „	16th	2,610	7.45	4.30 „ 10.15
	1,085	11.15 „	17th	795	6.15	4.0 „ 8.30
July 29th	1,740	8.15 „	18th	2,995	7.45	6.0 „ 10.0
	2,045	8.45 „	19th	2,765	7.15	4.30 „ 8.30
	1,180	11.15 „	20th	2,675	7.45	4.30 „ 8.30
August 22nd	865	7.15 „	21st	2,815	8.15	4.30 „ 9.30
	2,140	8.0 „	22nd	2,885	8.15	4.30 „ 10.0
	785	11.15 „	23rd	2,800	7.45	4.30 „ 10.0
September 15th....	880	6.30 „	24th	790	9.45	6.0 „ 10.0
	2,555	7.45 „	25th	715	6.45	6.0 „ 10.0
	805	11.15 „	26th	1,065	7.15	4.0 „ 10.0
October 30th	2,355	5.15 „	27th	2,335	7.15	4.30 „ 9.0
	2,695	7.30 „	28th	1,905	7.45	4.0 „ 9.0
	1,050	10.15 „	29th	2,745	7.45	4.30 „ 8.0
November 29th	1,180	4.15 „	30th	2,645	7.45	4.15 „ 10.0
	2,695	7.45 „	31st	775	6.45	6.0 „ 10.0
	1,070	10.45 „				

thought. Those who live in small rooms will be benefited as well as those who live in large, as purity of air and freedom from dirt will result in better health, less work in cleaning, and no injury to decorations.

The convenience arising from the employment of electrical energy for working motors is being more and more appreciated, and its uses are gradually extending. A leading London

paper is now advertised as being printed by electricity. Where economical power is available it opens out a wide field for encouraging the establishment of industries where small motors are required to be worked intermittently.

From a social as well as from an economic point of view, a municipal authority may regard this part of the electric-lighting business as another justification for their under-

taking it, especially where large populations are concentrated on a limited area. Simple labour-saving appliances, which involve no difficulties in working, and which do not lead to the vitiation of the air, are certain to be more and more relied on as a means of enabling some industries to be carried on in the houses of the workers instead of at factories where the motive-power is concentrated.

The destruction of town refuse is now recognised as about the best way of getting rid of it, both from a sanitary and financial point of view. The heat produced by the combustion of the refuse can be advantageously utilised for various purposes, amongst others for generating steam. This has led to the combination of a refuse destructor and electric-lighting station where the heat produced during the time of working the destructors can be applied to do the work of light loads or in aid of steam-boilers.

I am now, in conjunction with Mr. William N. Blair, the engineer of the St. Pancras Vestry, carrying out a combined destructor and electric-lighting station at King's-road, to serve other parts of the district, the outlay on which will be about £40,000 without distributing mains, which will connect it with the existing network, and will enable the heat produced during the day time to be utilised to do the work of charging the batteries and the light load over the whole district.

Having described the satisfactory results that have already been accomplished, I am confident that it only requires ordinary good administration for a still further degree of success to be attained, which will enable the Vestry either to lower its rate of charge below 6d. per unit, or to have a handsome amount each year to devote to the benefit of the rate-payers.

I desire to record my thanks to the members of my staff, and especially to my chief assistant, Mr. Thrupp, for their aid in carrying out these works.

In conclusion, I think the St. Pancras Vestry may be congratulated on the success that has attended their enterprise, which has fairly realised the anticipations and calculations upon which it was promoted.

DISCUSSION.

Mr. J. N. SHOOLBRED said that the impression conveyed, at the beginning of the paper, that in 1883 St. Pancras was the only local authority who obtained a Provisional Order for Electric Lighting, was not

correct. For in 1883 there were at least five other local authorities—Bradford, Brighton, Carlisle, Scarborough, and Richmond (Surrey), who obtained Provisional Orders, in addition to St. Pancras, though the latter parish had the great merit of having been the first metropolitan local authority to do so. Professor Robinson had referred to the peculiar circumstances that about that time municipal authorities began to awake to the fact that it would be better to keep electric lighting in their hands than in the hands of public companies; but he did not think the fact of the second Act being passed—which made the terms of purchase more onerous—really had anything to do with the matter, that Municipal authorities gradually had their eyes opened to the fact that they could themselves undertake the supply of electricity without loss to the community. He congratulated the reader of the paper on the success which had attended the working of the installation in St. Pancras. The high public spirited policy of this parish in lighting by electricity so large a proportion of the public thoroughfares, was now being appreciated. At Bradford the assessments for the last six months had just been published, and the results in this town were enhanced by the fact that no public lighting was undertaken. The committee there considered that before undertaking the lighting of the streets it would be better to secure a good revenue from private lighting, in order to pay for the lighting of the streets. The price paid for coal was 8s. a ton; but the difference in the cost of coal between that place and a town in the South of England might generally be met by an increase of one penny per unit sold. At Bradford, the price per unit was 5d., as against 6d. in St. Pancras. During the last six months the total receipts in Bradford had been £5,638, the working expenses £2,851, leaving a net balance of £2,787. It was a curious thing, that for the last three years the working expenses had been about 50 per cent. of the gross receipts, a fact which in itself was quite sufficient to account for the success of any industrial undertaking. He had had the pleasure some two years ago, in that room, of giving a statement with regard to the first two years' working at Bradford; and he might now, perhaps, be allowed to continue that, in order to show the great increase which had been going on in the demand for lighting power. In 1890, the working expenses amounted to £2,073, and the receipts £2,411, leaving a balance of £338. In 1891, the working expenses were £2,852, the gross receipts £5,385, leaving a balance of £2,833. In 1892, the working expenses were £3,935, and the gross receipts £7,914, leaving a balance of £3,987. In 1893, the working expenses were £5,104, the receipts £10,185, leaving a balance of £5,081. This had been devoted to paying interest and sinking fund to the amount of £1,390 in 1886, £1,780 in 1891, £2,511 in 1892, and £3,200 in 1893. The further balance remaining was carried forward to profit and loss account. The outcome was that the Corporation had been able to meet the interest

and sinking fund from the very construction of the works, which amounted to 7 per cent., and, latterly, to carry forward about £1,000 a year. The capital account, which originally began with £18,456 in 1889, had gradually risen to £56,769. He did not claim anything special for the Bradford Corporation except that the undertaking was well managed. There was no reason whatever why this success should not be imitated in other places. He believed that in Brighton the results were likely in time to exceed those which he had mentioned. The Corporation of Bradford desired to respond to any inquiries made by other municipal bodies on these matters. He thought the fact of the advisability of electric lighting works being undertaken by municipal authorities was now being recognised by ratepayers at large. At Bradford the first loan was obtained for a period of thirty years; but since then the Local Government Board had gone into the matter very closely, and their uniform rule was now only to allow twenty-five years.

Mr. ALEXANDER SIEMENS said the previous speaker, as well as the reader of the paper, had begun with a historical statement, but the meeting had not heard the history far enough back, because there were at least two towns, namely, Hull and Liverpool, which obtained special Acts before the passing of the Electric Lighting Act of 1882. Nothing particular had come of this. At Hull a trial installation was made and afterwards abandoned. Brighton also obtained an Act, and afterwards a Provisional Order. Prof. Robinson had been kind enough to quote some remarks which he made in his address delivered to the Institution of Electrical Engineers, and he was very glad to know that they had two such good examples to confirm what he then said, that municipal corporations were the proper people to take electric lighting in hand, and to let ratepayers have the benefit, when people spent their money on such luxuries. He did not know that he should be right in raising a storm about the high and low tension systems, but he might call attention to the fact that both the systems which had been successful were low tensions. The new sub-station of St. Pancras would be 2,700 yards away from the central station, so that it was not too much to say that a low-pressure system on the three-wire plan could be easily adopted for a two-mile radius. This would cover a good deal of ground, and would enable most towns to adopt a system which, after all, was best suited for a great many purposes. He did not wish to run the high-tension system down, simply because it was high tension; he only wished to call attention to the fact that in each case it was absolutely necessary to study what was the best system to be applied. His firm were now carrying out several stations with high-tension currents, and also some with low tension. It was simply a question for the consulting engineer to calculate out which was the cheapest system to adopt. There was no intrinsic merit in either system

which made it applicable in all cases. Professor Robinson had mentioned the standard of light of public lamps, and, curiously enough, he was thinking of the same subject when walking along the Thames Embankment that evening. The effect of coming from the City streets on to the Embankment was curious, and it showed what people had put up with for so long under what was termed street lighting. Most of the ordinary streets were very well lighted by the numerous private lights which shone out of the windows, but whenever you got to a street where there were only gas lamps, making darkness visible, the electric light was a very great improvement, and help for the traffic. Another controversial matter was the conduit system as compared with the cable system, into which he would not now enter. The extensions at present being made in St. Pancras were made by lead cables, which he considered a considerable improvement over the old plan.

Mr. GISBERT KAPP thought that anyone who had been to the St. Pancras-station could not but have been struck with the many ingenious novelties there introduced, such, for instance, as the condensing plant, which was a very valuable addition to the station. He noticed that Professor Robinson had introduced the method of working arc lamps in parallel series, and that this plan had been entirely successful. Another thing which was original was the method of working sub-stations by means of transformers for working the batteries in series. The amount of coal used in the low pressure system appeared to be 12 lbs. for every unit sold, and at Bristol the amount was not very different. There the system adopted was the high pressure, and the distributing mains were low pressure; they had eleven sub-stations, and a continuous current system was out of the question. At Bristol they had to carry the current a distance of over 2 miles, and as demands for extensions were coming in very fast they had to consider how they could get new machinery, and how they could lay down new cables, so as to reach the further parts of the city. Distance in the choice of a system was not everything. Of course if they had a compact district where the houses were high, and standing close together you could have a large number of lamps per acre, but in provincial towns you could not afford to put in low tension conductors right away from the station, but you must have some intermediate system. In Bournemouth or Beckenham one would have to go a number of miles before selling 1,000 lamps, and in such places high tension would have to be used. Bristol was in an intermediate condition; there they had a fairly dense amount of lighting to do in the town itself, but they had also to reach outlying residential districts, and consequently they used the alternating current. The steam plant was exceedingly satisfactory, and the coal used was of an exceedingly cheap kind.

Mr. R. S. ERSKINE said he should be glad to have

some further information about the condensing plant and the cost of pumping the water over the corrugated roofing. No doubt many persons preferred the culvert system to the cable system, and given a fair amount of room, he thought the culvert system was the best.

Mr. ECCLESTON GIBBS said as the question of loans had not yet been touched upon he might perhaps be allowed to make a few remarks. Under the instructions of the Vestry, he had brought to the notice of the County Council the desirability of allowing the local authorities to charge the first cost of electric lighting over a sufficiently long period to enable them to sell the current at what was thought to be a fair rate. But if they had to pay back the capital in 25 years, the result would be that the first generation who used electricity would have to pay a big price for it, whereas cheap electricity would be reserved for the next generation. This was not as it ought to be. A statement was published some two years ago by an engineer as to the cost of the first acquisition of water and gas companies, which, he understood, was brought about by spreading the initial cost over 60 or 80 years. Why a long period like that was not taken in the case of the electric light he could not understand. The argument of the St. Pancras Vestry was that the first charge being a charge on the rates, and not on the undertaking at all, the time ought to be a long one, because the ratepayers themselves bore all the risk, and, of course, if there was any profit, the ratepayers got it. They chose forty-two years, not because there was any magic about that term, but because that was the term fixed by Parliamentary Committees for companies, and their calculations went to show that if they could get the money for forty-two years they could sell the current at 6d. per unit, possibly less, and the day supply at 3d. If they were to be confined to twenty-five years, all the calculations would have to be revised. As the County Council had been advocating that the whole system of taxation was wrong, it seemed all the more unfair to put on the present generation of ratepayers a heavy charge in working out a big municipal enterprise. One would have thought that the County Council, from their preaching, would have been the last people to obstruct a local authority in carrying out a great undertaking like electric lighting. However, there was no appeal from their decision, apparently, and it was a question with his vestry what they should do when additional plant was bought. He should be glad if anyone could inform him whether the twenty-five years term applied to the original capital only, or if they were allowed to borrow from time to time for renewals and maintenance. If this could be done, the County Council had expressed their willingness to agree, and the result would be that instead of lending £100,000 to St. Pancras for forty-two years, they would lend about £250,000 during that time for original outlay and renewals. If it were possible to

borrow for renewals, the renewal fund would be a perpetual loan fund.

The CHAIRMAN asked whether the £88,000 already borrowed to carry out the installation had been borrowed on the forty-two years system.

Mr. GIBBS replied that the whole of this sum had not been borrowed from the County Council, as that body could only lend money for the purchase of land for 32 years, and the greater portion had been borrowed from the Prudential Company. Some of the money had been borrowed for 42 years, at $3\frac{1}{2}$ per cent. interest.

Mr. DRUITT HALPIN said that, with reference to Mr. Erskine's query about condensers, he would offer some remarks on a system of condensation he had lately seen on the Continent, which he thought would be very suitable for stations working in towns where condensing water was not available, and where the nuisance caused by steam passing off was very great. In this plant the whole power to be provided for was about ten to twelve thousand horse-power, and when he saw it at work already between two and three thousand horse-power was actuated by it. The arrangement consists of an ordinary jet condenser worked by a special engine, and dealing with the steam from a number of engines about the works. This jet condenser only had a supply to keep it going for about ten minutes, and after the water had been warmed by passing through the condenser, it was pumped up to the top of a light wooden building, and then ran down over boards placed vertically, adhering to the edges of the boards by capilarity. The boards were in two lengths, the upper and lower lengths being placed at right angles to each other, in order to ensure the water being broken up. At the bottom, air was driven into this structure by a fan, worked by the same engine which actuated the centrifugal pump for lifting the water from the tank in which it was received from the condenser, to the top of the boards. This air passes up between the boards, which were a slight distance apart, and effects the cooling partly by carrying heat away, and partly by evaporation. The water was cooled to about 80° Fahr., but it was found that this water was capable of producing as good a vacuum as water ordinarily does at a temperature of from 50° to 55° Fahr. This can easily be explained by the fact that this water was almost completely devoid of air. Passing through and through the condenser continually the air is taken out, and when passing through the arrangement of boards the air pressure is so slight from the fans, and the time is so short, that there is no opportunity for it to absorb air again before returning into the condenser. The quantity of water carried away in evaporation by this arrangement was about half the total quantity of feed water passing through the engines, so that a quantity of water, equal to about half the volume of the feed

water, had to be continually run to waste to prevent an undesirable accumulation of water. As the whole of this apparatus is so very light, cheap, and simple, he thought it was specially adapted for placing on the roofs of central stations in London and elsewhere, in order to obtain the economy due to condensing, and also to avoid the nuisance of steam passing into the atmosphere.

Mr. W. H. PATCHELL said he gathered from the paper that, at St. Pancras, they had one engine for actual condensing, and one for cooling; and he should be glad to know the actual cost per unit? He also wished to know whether the condenser was used solely for the light load or during the whole 24 hours, and how the meters were arranged? The question of the day load was a most important one to all concerned, and unless it could be properly ascertained, he thought electric companies were liable to be cheated.

Mr. B. M. JENKIN thought the working expenses, as given in the paper, would have to be increased if it were necessary to have a battery at the sub-station. Perhaps the reader of the paper would give some information on this point, as well as the result of pumping air into the culvert. How far along the culvert was sufficient pressure maintained in order to keep the gas out? He also wished to know how many arc lamps were run in a series?

Mr. MORSE asked whether, in the calculation of cost, anything had been put down as an equivalent to management by a company. Of course, local authorities had immense advantages in having voluntary management by a committee, but in order to arrive at a comparison, something for management should be charged. It was, no doubt, important that municipal authorities should undertake the electric lighting, but in sparsely inhabited districts it was a difficult matter for the authorities to deal with an account of the expense, and in his own district, although he was in favour of the electric light, he had entered the Local Board in order to vote against the matter being undertaken at the cost of the ratepayers.

Mr. SWEET said the day supply in St. Pancras was arranged in a peculiar way—they had two series of wires, one for the night supply and one for the day supply. When the current was running through the 6d. meter all the lights could be used, but when running through the 3d. meter only a certain number could be used. The use of the 3d. or 6d. meter was entirely at the option of the customer. His vestry, at one time, thought of obtaining a Bill of their own from Parliament as a sort of protest to the action of the County Council with regard to the repayment of borrowed money which, in his view, ought to be spread over a greater number of years.

Professor H. ROBINSON said the observations of Mr. Shoolbred were very interesting as affording information with reference to the work at Bradford; with the permission of the meeting he would alter the statement in the paper "that St. Pancras was the first municipal authority" to "one of the first." He had not intended to enter into the relative merits of the culvert and cable systems; he believed there was an opening for both, and had adopted both. When he first adopted the culvert system the cable system was not available. He felt sure that local authorities fully appreciated the work done in the past by electric companies, who were really the pioneers in the matter, and corporations were now utilising the work on which companies had spent their capital. He had carefully avoided touching upon controversial matters, believing that it would be impossible in the course of one evening to thresh out the question of high and low tension. When one had to supply distant points the question of high tension came into consideration, but whether it was to be the alternating or continuous current was not the question before the meeting. Under certain conditions, for long distances, and many purposes, the alternating was admirably suited, but the alternating would not do for St. Pancras Vestry what the continuous current had done. His paper had merely been written to put on record the facts connected with the installation at St. Pancras up to the present day, and at a future date, when the station was thoroughly at work, he should be happy to give the information desired by the various speakers. The advantage of a sub-station was that light loads could be supplied from it. The question raised by Mr. Eccleston Gibbs as to whether a person or body with good credit should not have the benefit of it, by being allowed a longer time in which to repay a loan, was a most important one. For his own part, he thought it would be more equitable to distribute the repayment over fifty than twenty-five years.

The CHAIRMAN, in proposing a vote of thanks to Professor Robinson, said he wished to mention two matters as part of the history of the subject. The first place publicly lighted in London was the Thames Embankment by the Metropolitan Board of Works, in 1879 or 1880; and next, the city of London spent no less a sum than £12,000 in trying the experiment of lighting up the streets. The enterprise and energy of the city authorities did more to introduce electric light work than the action taken by any other local authority. The most important point to his mind was the question of municipalisation of electric lighting. The introduction of these industries into the politics of local authorities had an immense bearing on the future of the economics of our rate system. The introduction of electric lighting to ratepayers would be of no benefit whatever if it did not directly or indirectly lead to the relief of the rates. His own view was that ultimately the electric light must become the poor man's light. The introduction

of a light which did not vitiate the air of a room was of far greater importance than the question of whether the loan should be repaid in 30, 40, or 50 years. Electric lighting, as a municipal industry, was going to pay, and, as a result, rates would be lessened. He had been very much struck by the action of one municipal body on the south side of the water, viz., Southwark, which had absolutely declined to re-appoint the Electric Light Committee as they considered the installation would be a great expense and loss to the ratepayers. In no instance that he was aware of where a municipal authority had taken up the matter had it been found necessary to make a call upon the ratepayers. Electric lighting had been taken up by St. Pancras, Brighton, Bristol, Bradford, Worcester, Dundee, Hull, Blackpool, Kingston, Burnley, Huddersfield, Barnsley, Bacup, Burton, Derby, Nottingham, Oldham, Wolverhampton, Yarmouth, York, Southport, Aberdeen, Dewsbury, Hanley, Edinburgh, and Glasgow, and he was sure they would all reap the benefit of so doing. He was a great advocate for street lighting, and thought that if Bradford had followed the example of St. Pancras they would have found it paid better than was now the case. Street lighting was a great advertisement; it had the effect of making every ratepayer, however poor, feel that he had an interest in the industry, and it diminished the dangers of the streets, besides assisting the supervision by the police and generally adding to the comfort of the community. One word as to the danger of electric lighting. They had lately had one or two instances of explosions in junction boxes and street pipes, but this was not attributable to electricity, it was caused by the condition of the gas-pipes. The remedy was very simple, viz., to keep the gas out of the pipes and boxes, and no one was more anxious to do this than the gas companies themselves. There was no source of danger of any sort or kind which had shown itself that was not remediable. He read the other day in the papers that a horse had been killed at Bournemouth by the electric current, and as great prominence was given to the fact, he might be pardoned for mentioning the following figures:—20,000 people were killed every year from accidental causes; probably 19,900 did not appear in the papers, but if one person was killed by the electric light all the papers immediately took it up. It was the same with fires. In 1893, 3,410 fires occurred in the City of London; of these, only 5 were attributable to the electric lighting wires, while 284 were attributable to gas, 235 to candles, and 556 to oil.

The vote of thanks having been unanimously passed, the meeting adjourned.

Miscellaneous.

THE SALT INDUSTRY IN GERMANY.

According to the *Vierteljahrshefte zur Statistik des Deutschen Reichs* for 1893, the total number of

German rock salt mines amounts to fourteen, seven belonging to the State, and seven to private individuals; the number of salines is sixty-two, twenty-one belonging to the State, and forty-one to private individuals. The number of establishments partly producing salt was fifteen. The amount of salt produced during the year 1892-93 comprised 575,000 tons of rock salt, and 504,000 tons of refined salt. In the year 1891-92, the corresponding figures were 597,000 tons of rock salt, and 512,000 tons of refined salt. It therefore appears that this industry was not quite so flourishing last year as it was in the year before. As regards native salt, 363,000 tons were used for purposes of food in 1892-93, against 364,000 tons in 1891-92, and 508,000 tons (against 480,000 tons in 1891-92) were used for other purposes, and not subject to taxation. The exportation to foreign countries of German salt amounted to 192,000 tons, against 255,000 tons in 1891-92. The greatest decrease in exports was with regard to British India, which took 56,000 tons less German salt in 1893 than in 1892. No very large amount of foreign salt is imported into Germany, the total quantity averaging about 25,000 tons annually. This chiefly consists of salt of English origin, which is largely consumed in Eastern and Western Prussia, Schleswig-Holstein, and Hamburg. The consumption of native and foreign table salt in the German Customs Union amounted, in 1893, to 363,000 tons, which gives, as for preceding years, a consumption per head of population of 7·6 kilogrammes (about 17 lbs. avoirdupoise). In addition to this quantity, 508,000 tons were used by the soda and sulphate of soda factories, the feeding of cattle, and in the colour, chemical, mining, and leather industries.

General Notes.

HUNGARIAN RAILWAYS.—From an official statement, it appears that the passenger mileage on the State railways in 1892 was 218 per cent. greater than in 1888, which was the year before the introduction of the zone tariff, the mileage of the system being increased 11 per cent. The passenger earnings have increased 40 per cent.

PETROLEUM IN ENGLAND.—The discovery of petroleum on the Mendip-hills has recently been announced. A well at Ashwick-court, two miles north of Shepton Mallet, has long been known to yield water slightly flavoured at times with petroleum. A considerable flow of oil is said to have taken place in July, 1892, when the water-level was low, and this has continued at intervals, but in smaller quantities, since that date. Ashwick is shown on the Geological Survey map to stand at the northern edge of the carboniferous limestone; the beds have a high dip to the north, passing under the

millstone grit and the coal-measures of the Radstock area. Indications of petroleum are also known in other wells and springs in the neighbourhood. The matter is now being investigated by Mr. Boverton Redwood and Mr. W. Topley, under whose directions further explorations will be made.—*Nature*.

LONDON FIRES.—It appears, from the report of the chief officer of the Fire Brigade to the London County Council, that the fires of 1893, compared with those of 1892, show an increase of 264, or, compared with the average of the past ten years, an increase of 997. The number of fires in 1892 was 3,146 (serious, 177, slight, 2,969); those of 1893 amounted to 3,410 (serious, 180, slight, 3,230). The average for the ten years, 1883 to 1892, was 2,413 (serious, 166, slight, 2,247). The number of fires in the metropolis in which life has been seriously endangered during the year 1893 has been 107, and those in which life has been lost has been 45. The total number of calls during the year, including those for actual fires, supposed fires, chimney fires, and supposed chimney fires, has been 6,462, or nearly 18 a day; of 1,163 false alarms received during the year, 606 have been malicious calls sent through the fire-alarm call-posts.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

FEBRUARY 21.—“Electric Signalling without Wires.” By WM. HENRY PREECE, C.B., F.R.S. SIR RICHARD WEBSTER, G.C.M.G., Q.C., M.P., Chairman of the Council, will preside.

FEBRUARY 28.—“Rainfall Records in the British Isles.” By G. J. SYMONS, F.R.S. SIR FREDERICK BRAMWELL, Bart., D.C.L., F.R.S., will preside.

MARCH 7.—“Refrigerating Apparatus.” By PROF. CARL LINDE.

Papers for which dates have not yet been fixed:—

“Reproduction of Colour by Photography.” By CAPTAIN W. DE W. ABNEY, C.B., F.R.S.

“London Coal Gas and its Enrichment.” By PROF. VIVIAN LEWES.

“Experiments in Aeronautics.” By HIRAM S. MAXIM.

“Automatic Gem and Gold Separator.” By WILLIAM S. LOCKHART.

“Application of Electricity to the Disinfection of Sewage.” By MONS. HERMITE.

“Design Applied to Carpets.” By ALEXANDER MILLAR.”

INDIAN SECTION.

The meetings of March 8, April 26, and May 24, will be held at the Society of Arts; the meeting on March 19 will be held at the Imperial Institute.

THURSDAY, MARCH 8, at 4.30 p.m.—“The Indian Currency.” By J. BARR ROBERTSON.

MONDAY, MARCH 19, at 8.30 p.m.—“Indian Railway Extension: its Relation to the Trade of India and of the United Kingdom.” By JOSEPH WALTON. SIR JAMES KITSON, Bart., M.P., will preside.

THURSDAY, APRIL 26, at 4.30 p.m.—“Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh.” By SIR AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieutenant-Governor of the North-West Provinces and Oudh.

THURSDAY, MAY 24, at 4.30.—“Chota Nagpore; its Mineral Wealth and its value to India.” By J. F. HEWITT, late Bengal Civil Service. SIR ALEXANDER WILSON, formerly President of the Bengal Chamber of Commerce, will preside.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on Tuesdays, at Eight o'clock:—

FEBRUARY 20.—“The Arts and Industries of Belgium, and the Antwerp Exhibition, 1894.” By EDOUARD SEVE. SIR ALBERT K. ROLLIT, LL.D., M.P., Vice-President of the Society, will preside.

MARCH 6.—“Travels on the Zambesi.” By MONS. FOA.

APRIL 17.—“Tasmania and the forthcoming Hobart International Exhibition, 1894-95.” By J. F. ECHLIN.

MAY 1.—“Paraguay.” By A. F. BAILLIE.

MAY 29.—“Education in Victoria.” By Prof. C. H. PEARSON, M.A., LL.D.

APPLIED ART SECTION.

Tuesday Evenings, at Eight o'clock:—

FEBRUARY 27.—“Goldsmiths' Work: Past and Present.” By MRS. PHILIP NEWMAN. I. HUNTER DONALDSON will preside.

APRIL 10.—“The Evolution of Decorative Art.” By HENRY BALFOUR, M.A. SIR GEORGE BIRCHWOOD, M.D., K.C.I.E., C.S.I., will preside.

MAY 8.—“Pewter.” By J. STARKIE GARDNER. PROF. W. C. ROBERTS-AUSTEN, C.B., F.R.S., will preside.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock :—

HUGH STANNUS, F.R.I.B.A., "The Decorative Treatment of Traditional Foliage."
Four Lectures.

LECTURE I.—FEB. 19.—The *Leaf* and its edge : Origin in architecture, and not in textile patterns—Artificial, and not copied from any particular plant—General shapes—Varieties of edge-treatment—May be codified on principles deduced from Nature.

LECTURE II.—FEB. 26.—The *Stem* and its clothing : Growth line of Main-stem—Of branches—Principles deduced from Nature—The Law of exhaustion—The Sheath-leaf—Technical treatment.

LECTURE III.—MARCH 5.—The *Flower* : Principles deduced from Nature—Position—Attitude—View—Varieties—The *Tendril* : Diffusion of ornamental detail.

LECTURE IV.—MARCH 12.—*Applications* : The Stalk-leaf—Sheath-leaf—Cup-leaf—Rosette—Korinthian leaf—Moulding enrichment.—*Varieties* : The Canon not closed—Individual treatments—Wealth of suggestion in Nature—Further developments.

CAPTAIN W. DE W. ABNEY, C.B., F.R.S.,
"Photometry." Three Lectures.

April 2, 9, 16.

HENRY CHARLES JENKINS, A.M.Inst.C.E.
"Typewriting Machines." Two Lectures.

April 30; May 7.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 19 ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Hugh Stannus, "The Decorative Treatment of Artificial Foliage." (Lecture I.)

Imperial Institute, South Kensington, 8½ p.m. Dr. Bowdler Sharpe, "Some Features of Home and Colonial Bird Life."

Cleveland Institute of Engineers, Middlesbro', 7½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m.
Paper on "The Physical Conception of Nature."

London Institution, Finsbury-circus, E.C., 5 p.m.
Mr. J. Gollancz, "English Bards of the Welsh Marches."

TUESDAY, FEB. 20 ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Foreign and Colonial Section.) Edouard Sève, "The Arts and Industries of Belgium and the Antwerp Exhibition, 1894."

Royal Institution, Albemarle-street, W., 3 p.m.
Prof. Charles Stewart, "Locomotion and Fixation in Plants and Animals."

Sanitary Institute, 74A, Margaret-street, W., 8 p.m.
Mr. J. Wright Clarke, "Details of Plumbers' Work."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. R. H. Tweddell, "Forging by Hydraulic Pressure."

Statistical, Geological Museum, Jermyn-street, S.W., 7½ p.m. Lord George Hamilton, "Ocean Highways : their Bearing on the Food and Wages of Great Britain."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Dr. R. W. Shufeldt, "A Method of Preserving certain Invertebrata for Museum Exhibition." 2. Dr. O. F. von Moellendorff, "A Collection of Land-Shell from the Samui Islands, Gulf of Siam." 3. Prof. P. R. Uhler, "A List of Hemiptera Heteroptera of the Families *Anthracorida* and *Ceratoconidae*, collected by Mr. H. H. Smith in the Island of St. Vincent, with Descriptions of new Genera and Species."

East India Association, Westminster Town Hall, S.W., 2½ p.m. Lieut.-Gen. A. Phelps, "The Secret of Anglo-Indian Rule."

WEDNESDAY, FEB. 21 ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. William H. Preece, "Electric Signalling without Wires."

Meteorological, 25, Great George-street, S.W., 8 p.m. 1. Dr. J. Cleasby Taylor, "Temperature, Rainfall, and Sunshine at Las Palmas, Grand Canary." 2. Mr. Edward Mawley, "Report on the Phenological Observations for 1893." 3. Mr. William Marriott, "Comparative Observations with Two Thermometer Screens at Ilfracombe."

Geological, Burlington-house, W., 8 p.m. 1. Sir Archibald Geikie, "The Relations of the Basic and Acid Rocks of the Tertiary Volcanic Series of the Inner Hebrides." 2. Sir J. W. Dawson, "Note on the Genus *Naiadites*, as occurring in the Coal Formation of Nova Scotia." With an Appendix by Dr. Wheelton Hind.

Microscopical, 20, Hanover-square, W., 8 p.m. Prof. G. S. Brady, "Fucitrogus Rhodymenia, a Gall-producing Lopepod."

Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, FEB. 22 ... Royal, Burlington-house, W., 4½ p.m. London Institution, Finsbury-circus, E.C., 6 p.m. Mr. Lionel Monckton, "Opera—its evolution and present tendency."

Royal Institution, Albemarle-street, W., 3 p.m. Mr. W. Martin Conway, "The Past and Future of Mountain Exploration."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. Gisbert Kapp, "A Method of Testing the Magnetic Qualities of Iron." 2. Mr. W. M. Mordey, "A Note on Parallel Working in Long Lines."

Camera Club, Charing-cross-road, W.C., 8 p.m. Captain W. de W. Abney, "Hyper-Instantaneous Photography."

FRIDAY, FEB. 23 ... United Service Inst., Whitehall-yard, W., 3 p.m. Lieut. W. Anstruther-Thomson, "Machine Guns with Cavalry."

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Prof. Silvanus Thompson, "Transformations of Electric Currents."

Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Mr. W. C. Tyndale, "House Drainage."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Science Schools, South Kensington, S.W., 5 p.m. 1. Mr. Littlewood, "A Method of Determining Refraction Indices." 2. Mr. Thomas H. Blakesley, "A New Electrical Theorem." 3. Prof. C. V. Boys, "The Attachment of Quartz Fibres."

SATURDAY, FEB. 24 ... Botanic, Inner-circle, Regent's-park, N.W., 3½ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Lord Rayleigh, "Light : with special reference to the Optical Discoveries of Newton."

Journal of the Society of Arts.

No. 2,153. VOL. XLII.

FRIDAY, FEBRUARY 23, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

On Monday evening, 19th inst., Mr. HUGH STANNUS, F.R.I.B.A., delivered the first lecture of his course on "The Decorative Treatment of Traditional Foliage," in which he dealt more particularly with the leaf and its edge.

The lectures will be printed in the *Journal* during the summer recess.

Chicago Exhibition, 1893.

MEETING OF THE ROYAL COMMISSION.

A meeting of the Royal Commission was held on Monday, 17th inst., at 4.15 p.m. Present: Sir Richard Webster, Q.C., M.P., in the chair; Sir Frederick Abel, Bart., K.C.B., D.C.L., D.Sc., F.R.S., William Anderson, D.C.L., F.R.S., Sir George Birdwood, K.C.I.E., C.S.I., LL.D., M.D., Sir Edward Birkbeck, Bart., Sir Frederick Bramwell, Bart., D.C.L., F.R.S., George Ledgard Bristow, Michael Carteighe, R. Brudenell Carter, F.R.C.S., Francis Cobb, Prof. James Dewar, M.A., LL.D., F.R.S., Major-General Sir John Donnelly, K.C.B., Sir Henry Doulton, James Dredge, Prof. Clement Le Neve Foster, D.Sc., F.R.S., Sir Douglas Galton, K.C.B., D.C.L., F.R.S., Walter H. Harris, Sir Charles Malcolm Kennedy, K.C.M.G., C.B., Sir Thomas Villiers Lister, K.C.M.G., John Biddulph Martin, John Fletcher Moulton, M.A., Q.C., F.R.S., Florence O'Driscoll, M.P., Sir Westby B. Perceval, K.C.M.G., William Henry Preece, C.B., F.R.S., Sir Owen Roberts, M.A., D.C.L., F.S.A., Prof. William Chandler Roberts-Austen, C.B., F.R.S., Sir Albert Kaye Rollit,

LL.D., M.P., Sir Saul Samuel, K.C.M.G., C.B., with Sir Henry Trueman Wood, M.A., Secretary.

The following correspondence on the representation of Great Britain at the Exhibition has been received from the Secretary of State for Foreign Affairs:—

Embassy of the United States, London,
January 30th, 1894.

The Earl of Rosebery, K.G., &c.

MY LORD,—Under instructions of my Government I have the honour to transmit herewith a copy of a joint Resolution of the Senate and House of Representatives of the United States approved by Executive, October 28th last, expressive of the sense of the Government and People of the United States of the generous and effective co-operation of the various foreign Governments in the Quadri-Centennial Exposition lately held at Chicago in commemoration of the discovery of America by Christopher Columbus.

It is my welcome and pleasing duty in transmitting this joint Resolution to convey also in their behalf an expression of the gratification and high appreciation of the people of the United States and their Government for the friendly and valuable contribution by her Majesty's Government and the people of Great Britain, their Colonial dependencies, and vast Empire, towards this memorable and impressive display of the arts, industries, and products of the world.—I have, &c.,

(Signed) T. F. BAYARD.

PUBLIC RESOLUTION. NO. II.

Joint resolution, "That the acknowledgments of the Government and people of the United States be tendered to various foreign Governments of the world who have participated in commemoration of the discovery of America by Christopher Columbus."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled:—

"(1.) That it is the sense of Congress that the acknowledgments of the Government and people of the United States, be tendered to the various foreign Governments of the world who have so generously and effectively co-operated in the Quadricentennial Exposition held in Chicago, in commemoration of the discovery of America by Christopher Columbus.

"(2.) That the President of the United States be requested to communicate to each foreign Government that has participated in said Exposition the acknowledgment of Congress for its contribution."

Approved October 28th, 1893.

Foreign-office,
February 10th, 1894.

His Excellency, T. F. Bayard, Esq.

YOUR EXCELLENCY,—I have the honour to acknowledge the receipt of your note of the 30th ultimo, inclosing a copy of a joint Resolution, passed by the Senate and House of Representatives of the United States, and approved by the Executive, expressing the sense of the Government and people of the United States of the co-operation of the various foreign Governments in the Exhibition lately held at Chicago.

Your Excellency was good enough to add an expression of high appreciation of the contribution made by the British empire to the Exhibition; and, in thanking you for this communication, I beg to assure your Excellency that the substance of your note, and the generous terms in which it is couched, constitute a highly-prized testimony to the participation of this empire in the celebration of the four hundredth anniversary of the discovery of the New World.

I have, &c.,

(Signed) ROSEBERRY.

Proceedings of the Society.

INDIAN SECTION.

Thursday, February 15, 1894; the HON. GEORGE N. CURZON, M.P., in the chair.

The paper read was—

EXPERIENCES AT THE COURT OF AFGHANISTAN.

BY JOHN A. GRAY,

Late Surgeon to His Highness Abdurrahman Khan, Amir of Afghanistan.

To give you some idea of Afghanistan, I think I cannot do better than tell you what specially attracted my own attention when I first entered the service of the Amir. Afterwards one became familiarised with Oriental life, and so ceased to notice many things that would strike a new-comer as interesting. I will, therefore, give you a brief description of the journey to Kabul; one's mode of life in different parts of the country; referring to the appearance and customs of the Afghans as the narrative progresses.

To reach Afghanistan you take ship to Bombay; you stop at Gibraltar and Malta, go through the Suez Canal, the Red Sea, and across the Indian ocean, landing in Bombay on the twenty-fifth day. From Bombay you take the train to Peshawar—the frontier town in the north of India—and arrive there in

about three and a-half days. From Peshawar to Kabul the journey is made on horseback.

Having obtained from the Indian Government the necessary permit to cross the frontier, we mounted our horses and rode out to Jumrood Fort, at the mouth of the Khyber Pass. We dined with the officer in charge, and, as he had no sleeping accommodation for guests, we wrapped ourselves in our ulsters and slept on the floor of the verandah. Next morning we found the Amir's guard, some forty mounted soldiers, waiting for us. Our baggage and tents were loaded on pack-horses, and our servants, the most important of which were an interpreter and a cook, put upon spare horses, and at 6 a.m. we started. This was in March, 1889. The Pass is open only on two days in the week, Mondays and Thursdays. The Indian Government pay the Khyberis some £7,000 annually to allow merchants to pass unmolested on those two days. The scenery in the Khyber is wild and rugged. At one time you are travelling at the foot of the mountains; then you gradually rise higher and higher till, half an hour after, you find yourself winding round the spurs of the mountains on a path cut out half way up the face of the cliff, with a sheer drop of some hundreds of feet to the bottom of the ravine. The mountains are completely barren of vegetation, and, in the summer, riding through the Khyber is a wearisome and very hot business. After a ride of some 10 or 12 miles, you reach Ali Musjid, called the key of the Khyber. Here there is a strong fort, which has been taken and re-taken by the British and Afghans, but is now, of course, in the possession of the British. At Ali Musjid the road comes to the foot of the mountains, where there is a stream of water and a few trees. We halted, the servants gathered some sticks, made a fire, and gave us tea. Then we rode on again.

The Pass opened out into a series of valleys. Here there were two or three Khyberi villages, with corn-fields round them. Each village is in itself a fort; it is built square, surrounded by a high wall with a tower at each corner, and is to be entered only by one gate. The wall is pierced for rifles. A great many of the Afghan and Hazara villages are built in this way. I have heard that it is not unusual, especially among the Khyberis, for one village to be at deadly feud with the next, so that there is a mutual interchange of courtesies in the way of robbery and murder. However, this sort of thing does not go on in the villages near Kabul.

At last we reached Lundi Kotal, a fortified serai belonging to the British, where travellers and merchants, with their camels, pack-horses, and merchandise, can take shelter for the night. This serai is very strongly fortified, and is generally in charge of a British officer. We put up at Lundi Kotal for the night, the officer giving us very comfortable quarters. The Amir's soldiers remained outside the serai. The next day we had to go through the Shinwarri country, and here the Khyber narrows up. We wound in and out round the spurs of the mountain, and up and down as before, but the guard closed round us and unslung their carbines, for the Shinwarris are not to be depended upon. In spite of the presence of forty or fifty men, the sensation of silence and solitude as you are traversing a mountain pass, overshadowed by great rocks, is rather remarkable. By-and-bye the Pass opened out once more, and we rode through a series of small circular valleys, surrounded by rocky mountains. There was a complete absence of anything green, and in the summer the heat is dangerous; it seems to be reflected into the valleys from the rocks. Smoke-coloured spectacles are essential in a ride to Kabul, and the costume I found most suitable and most comfortable was a sun helmet or a turban, a flannel shirt, and a thick tunic fitting rather loosely. We reached Dakkha, the first station belonging to the Amir. The colonel commanding came out to salaam us, and gave us tea in a tent on the high bank of the Kabul river—most enjoyable it was after the fatigue and heat. Then we rode on again through some hot pebbly valleys, with no vegetation. We reach Bassawal, tents were put up, guards stationed, and the servants made fires to cook our dinner. The fires were made some little distance from us, and we were not allowed a light in our tent, lest the Shinwarris should take a shot at us, so we had dinner in the dark. It was my first experience of a night under canvas. Next day we rode on to a place called Chardeh—four villages—and camped there. An Afghan khan, or gentleman, arrived, having been sent by the Governor of Jelalabad to welcome us. The following morning they woke us, as usual, before daybreak. The tents were struck and the baggage loaded up while we were breakfasting. We had camp chairs and a little portable iron table, but its legs got bent, and the enamelled iron plates had a way of slipping off, so we generally used a mule trunk instead. We sent the baggage off, and started ourselves about an hour afterwards.

We went through a series of fertile valleys, with corn-fields and fruit-trees, across a dry plain to the mountains again, then along the side of the Kabul river, on an excellent mountain road made by the British during the Afghan war. There is, in fact, a British road all the way to Kabul, though it is, or was, sadly in need of repair; but the natives have a way of taking what they think to be "short cuts"—down an awful path to the valley below, and then up an equally awful path on the other side. They do this rather than ride a further distance in and out among the spurs of the mountain on the level British road. As we were descending the mountain, we could see in the distance the great Jelalabad plain and the walled city of Jelalabad. I daresay you remember how that, in the retreat of the British army from Kabul, in 1842, Dr. Brydon was the only man who reached Jelalabad.

We arrived, entered one of the massive gates, and rode through the bazaars to the palace. Here the Governor received us in state; he invited me to sit on the seat by him. A page-boy waved a fan to keep off the flies. A crowd of people stood round. Sweets were brought, then tea and cigarettes, and a bouquet of flowers. We rested for awhile, and the Governor made many polite speeches. He asked me if I would like to see over the palace. The gardens around the palace are large, and well laid out with flowers and fruit-trees: when I was there the scent of orange flowers was overpowering. The palace is a large square building. The big central room has a domed roof. There are English carpets and curtains, chairs, tables, bookcases let in the wall, and vases and other ornaments. After taking leave of the Governor, I was shown into a pavilion in the gardens, where quarters were prepared for me. One of the khans gave me a dinner and provided for my guard, servants and horses. He came in after dinner and chatted with me. This man has considerable power in the neighbourhood of Gundamak, and I was advised to remember him in case it should ever be necessary for me to escape from Kabul. One could ride to Gundamak in a day, though it is a long way from Kabul. The following day the khan rode some distance with us. We put up at Tattang, where the Amir has a gunpowder factory. They showed me over it; the machinery is made of wood and is worked by waterwheels.

Next day's march was hot, and the glare was intense; fortunately it was a short march.

We went through a stony desert and over pebbly mountains to the Nimla Garden. This garden was made by Shah Jehangir and repaired by the present Amir. There is an avenue of cypress trees about 100 feet broad, with a stone-work water channel down the middle 10 or 12 feet broad with three cascades. There is a pavilion at one end of the avenue surrounded by flowers: here I put up for the night. We started off early next morning through more stony villages and over mountains. On the south was the great range of mountains called Safed Koh, or "white mountains," on the other side of which is the Kurram Valley. We passed Gundamuk and rode on to Surkh Pul (or the "Red-bridge"). This is an ancient brick bridge built over the River Surkhhab (a branch of the Kabul river), which comes roaring through a gorge in the mountains. The water of the river is red, or rather dark brown, from the colour of the mud in suspension. We boiled some of the water and had tea, then went on to Jagdalak. In 1842, during the retreat of the British army, out of 16,000 who left Kabul only 300 reached Jagdalak. We came down the long winding gorge, then climbed the mountain, on the top of which is the Jagdalak serai, where we stopped for the night. It is about 6,200 feet above the sea.

The scenery all round was wild and desolate in the extreme, and it was windy and cold in the serai. They found me a room over the gateway, made up a fire, and I had dinner. As usual, a guard was posted all night outside my door. Next day's march was over desolate and barren mountains to Sei Baba, a valley of pebbles, with a small stream running through it. In the middle of the valley is a tomb, and when we arrived we found a small party of vagrant peasants. One had died just as we arrived. They came to me for a "winding-sheet," so that they might bury him. There were no villages nearer than six or eight miles. The following day we climbed up over the Latabund Pass, 8,000 feet. This always seems to me the wildest part of the whole march. The mountains are so huge and rocky, the ravines appear so unfathomable. The road is on ledges of rock high up. On the highest peak of the mountains is what looked in the distance like a flagstaff. When I got nearer it seemed like a birdcage on a long pole. I found it was a huge iron cage, fixed on a mast. Once there was a man in the cage; his bones or their dust may be there now. They say that the road, some

eight years ago, was infested with robbers. The Amir determined to make an example of the next man he caught. It was the man in the cage. I never heard of there being any robbery afterwards. From this Pass you get the first view of Kabul. In the distance it seems a beautiful place, and after the long, desolate march, the sight of it, lying in the green Kabul valley, is delightful. We reached the foot of the mountains, put up at a place called Butkhak, and the next day rode into Kabul. The city is about 6,000 feet above the sea.

From this brief description of the journey to Kabul, you can form some idea of the general appearance of Afghanistan. Four-fifths of the country consist of rocks and mountains. The mountains are not of great height; they vary from 15,000 to 16,000 feet, except in the Hindoo Koosh range, where some peaks are over 20,000. The other fifth of the country, however, is exceedingly fertile. You come upon delightful valleys where there are gardens, orchards of fruit-trees, apples, pears, peaches, almonds; great stretches of vines; melons and pomegranates. Then there are fields of corn, barley, rice and maize, patches of brilliantly green clover. The peasants are exceedingly clever in the art of irrigating. They will bring water great distances in most ingenious, though roughly made, aqueducts. When they can obtain water, the great heat of the sun enables them to reap two crops of corn in the year.

Away to the west and north-west among the mountains in the Hazara country, where the heat is less and the rain more, there are large stretches of grass. These are the pasture lands for the flocks of sheep and herds of camels and horses belonging to his Highness and the richer Afghans. Many of the Hazaras are (or were) very rich in herds of camels or in horses. The Afghans and the Hazaras are quite distinct races. The Afghans are tall, big-boned men, with regular features, large eyes and full black beards. They are warlike and quarrelsome, but unless they are roused to religious frenzy by the priests, they can never fight a "losing battle." The Hazaras are much shorter men. They are of the Tartar type; have high cheek bones, small oblique eyes and scanty beards. They seemed to me to be hard-working, peaceful people; that is, unless they are roused by cruelty and oppression, and then they fight with dogged persistence. Though undersized, they are of great physical strength. They have too a certain simplicity which

contrasts them strongly with their neighbours. They live among the mountains in the centre and north-west of Afghanistan, and have been more or less independent for generations. Tamerlane (or Timour), was the last monarch who subjugated them, until the present Amir came to the throne. They are not the original inhabitants of the Afghan mountains, but are descended from a single tribe of Tartars (15,000 families), who were first settled in the country by Genghis Khan. They were divided into camps of 100 men and 1,000, Sud and Hazar. The former were absorbed into the latter, and the Hazaras remain. They increased greatly and spread over the mountains of the west and north-west of Afghanistan. It is curious that they should have completely lost their original language. They speak an old dialect of Persian. The Tartar type, however, remains, so it is impossible to mistake them. Both Afghans and Hazaras are Mahomedans, but the Afghans are Sunis, and many of the Hazaras, Shiahs, or believers in Ali, and these two sects are usually at bitter enmity, a fact which was useful to the Amir in the recent Hazara war. Further north, on the banks of the Oxus river, which separates Afghanistan from Russia, are Turkomans and Usbegs. The Turkomans were a Turkish race, living to the south of the Thian Shan (or celestial) mountains; and in the 11th and 12th century they overran Bokhara, Armenia, and Georgia. They are nomads, living in tents, or in a sort of wickerwork wigwam, dome-shaped, and covered with felt, called a *khirgar*. The smaller houses in Afghan Turkestan are built on the same model, dome-shaped. The *khirgar* can be taken down in an hour, and loaded on a camel. The Turkoman is a bigger man than the Hazara, of rough manners and coarse fibre, seeming more or less insensible to pain or sorrow. This cold, insensible nature contrasts strongly with the more amorous nature of the Afghans and Persians. Their wives are unveiled, and work in the camp or fields, and produce, also, the Turkestan carpets that are so much admired. The men have a strong tendency still to highway robbery; for this reason, when I was in Afghanistan, the Amir advised me not to go more than a mile from the city. The Usbegs are a similar race: Tartars, flat-faced, with scanty beards and slanting eyes; they have the same language (Turki), the same disposition, tastes, and ferocity as the Turkomans. They do not, however, lead a wandering life, but dwell in villages. The village life has brought out some con-

trasting points, so that the Uberg may be compared to a townsman, the Turkoman to a countryman, the citizen, and the peasant.

Some miles before you reach Kabul, you go along excellent roads, fringed with poplar trees, and the cultivated fields separated by irrigation ditches, lie to right and left.

We entered the Lahore gate. The streets of Kabul are narrow, and badly paved, and are generally crowded with people in their turbans and brightly-coloured garments. The shops are small and open, like stalls, having no front window. The bazaars—that is, the streets with shops in them—are roughly roofed over, to keep out the glare of the sun. I think the first thing that strikes you, when you enter Kabul—as, indeed, it does in nearly every native town in the East—is the general look of dilapidation and dirtiness.

For sale in the bazaars you see the native bread, made in large, flat, oval cakes, mutton, tea from Bombay, sugar and candles; teapots, cups and saucers, and trays from Russia; cloth and cotton goods from India; cheap vases and lamps from Germany; Norwegian matches; old British uniforms and army boots; patent leather boots, and long Russian riding boots; saddles and bridles—some from Lucknow, and some made in Kabul, from English leather—their thread, however, is not good, so that the latter soon tear at the seams.

As regards the manufactures of the country, they are few. There is a thick woollen cloth of a brown colour, called *barak*, something like Irish frieze. It is made from camels' hair. This is used for coats. It is good stuff, for, as they say in Kabul, "You can wear your coat for five years, have it turned, wear it five more, then give it to your servant." There is another brown cloth made in the neighbourhood of Herat; it is something like alpaca. They make Durbar coats of this cloth, and embroider them with brown braid in most complicated and artistic designs. Then there are the beautiful carpets made by the women of Turkestan—which are so much in demand in India—leather shoes, with turned-up toes, shawls, and quilted and gold embroidered caps, round which the turban is wound. The Kabuli ladies work these. The poorer people—the villagers and hill-men—weave with a hand-loom a coarse cotton cloth, for shirts and pyjamas, blue cotton cloaks and turbans, and make a thick white felted cloth. For the winter, they prepare the soft sheep-skin *posteens*, which are worn with the leather outside and the wool inside. A small one,

without sleeves, costs half-a-crown; larger one, five, ten, or fifteen shillings. A Kabul rupee is worth a shilling. There are rupees and pice—five pice make an anna, which is a nominal coin, and twelve annas a rupee. There are gold coins from Bokhara to be bought, but they are not in circulation.

The living houses—away from the bazaars—are arranged to ensure absolute privacy. A high wall, with one gate, encloses a square. On the inner side of the wall the house is built, generally one story high—sometimes more—with flat roof. There are no passages; a door leads from one room to another. In the open space is a garden, with trees and a well (or tank) of water. The houses vary in size and completeness just as they do in England. Some are very elaborate, with balconies, coloured glass windows, and have beautiful gardens, full of flowers and fruit-trees. (My house was of this kind.) Others have simply a paved yard, with a well in the middle, no glass windows, and only shutters, which push up to let in the light and air. This is very well in the summer, when everyone lives with the windows wide open night and day, but in the winter it is very inconvenient. As a rule, they then open one shutter only, and hang a piece of muslin over the open space—glass is very expensive. They keep themselves warm by means of a sandali. Over a charcoal brazier is placed a four-legged wooden stool, over this is thrown a large cotton-wool quilt. The people sit round cross-legged, pulling the quilt up to their chin; over the shoulders they throw a sheep-skin posteen. The men wear their turbans night and day, and the women have a little embroidered polo cap and a shawl of some kind.

Situated on the banks of the Kabul river, where it emerges from the gorge between the Asmai and Sher Derwaza mountains into the Kabul valley, are the Amir's workshops. These are extensive for such a country. There is a small steam-hammer, a stationary engine, lathes, cartridge plant, and a minting-machine. They were taken out by Mr. Pyne, the Amir's engineer. Trained Hindustani mistris, or workmen, are brought from India to work the machines, under the direction of Mr. Pyne and his European assistants. Many of the Kabulis, too, work in the shops. These, the townspeople, are not pure Afghans, but a mixed race of Afghan, Persian, and Hindustani. As artificers they are clever copyists. Give them a Martini-

Henry rifle, or a machine-gun, they will copy it so that to the untrained eye the two seem exactly alike. I do not say, however, that the weapon they produce is as serviceable as the one of British manufacture. Similarly, they will copy a carved oak chair. I saw one in the palace, and asked his Highness if it came from England. He said, "No; it was made in Kabul," but he showed me the English one it was copied from; they looked just alike. Dark carved wood, with leather seat and back. When, however, they attempt to evolve an original design the result is not so satisfactory. They turn out a variety of things from the workshops—guns, rifles, cartridges, portman-teaus, and boots. The rupees were formerly struck by hand; the present coin is much neater and prettier, but it is worth, I have been told, a penny less in the bazaars.

When I reached Kabul (April 6th, 1889) I heard that the Amir was in Turkestan, where he had followed his rebellious cousin Ishak. We were taken to the palace to see the eldest prince, Habibullah. He is about 24, and can speak a little English. Perhaps you have seen his portrait in the *Graphic*; it was taken from a painting I did of him in Kabul at the Amir's request. I was surprised to find the *Graphic* had a photograph of the painting.

The Erg Palace, where we were taken, is a fort surrounded by a moat, and contains the treasury, the Amir's private stores, great ranges of kitchens, quarters for the pages and servants, and includes (besides gardens) three separate enclosures surrounded by high walls. In these are—first, the Amir's pavilion; next, the harem serai; and, third, the official quarters of the princes. Each prince, however, has his own separate establishment in the city, where are his wives, his servants, and his horses. The Amir's pavilion is of curious design; his Highness told me he designed it himself. I think he got the idea from one of the churches in Tashkend. The design is, roughly speaking, that of a circle laid in the centre of a cross. The central hall is circular and domed, and four prolongations or alcoves lead at right angles from it. It is all one space; the alcoves are not cut off by doors.

In one alcove or room is the entrance. In the opposite one the Amir sits on his couch. He has his writing-table by him with paper, pens, and ink, though he never sits at it to write, but holds the paper in his hand. Persian writing is done slowly from right to left. He has always great banks of sweet-smelling flowers round him, and generally a canary in a

case or a parrot. There is a large window at the end of each alcove, opening out into the rose garden which surrounds the pavilion. The couch is a low one and is heaped with silken cushions, or, if the weather is cold, with furs. In the winter the Amir has a charcoal sandali, and in the central hall a stove for wood. A screen is arranged to cut off the draught from the door.

The day I first went it was, as I said, to see the prince, the Amir being in Turkestan. We passed the sentries, walked through the gardens, and entered the pavilion. The prince and all the chief officers in Kabul were seated in a semicircle in the central hall. The prince had an armchair, the others straight-backed chairs. Though Orientals, none were seated on the ground, and all were in European military uniforms, with astrakhan hats on their heads. The prince and the others shook hands with us; chairs were given us and tea and cigarettes brought. While we smoked, the prince made polite enquiries as to our health and whether we were fatigued with the journey. He spoke in Persian, the interpreter translating for us. By-and-bye, I noticed the prince suddenly turn pale. I wondered why, and kept my eyes fixed on him; presently I was aware of a rumbling noise; the windows rattled, the doors opened, and the lamps swung. The prince suddenly rose, and walked rapidly out into the gardens; every one jumped up and followed. It was my first experience of an earthquake.

I was a month in Kabul attending the hospitals and seeing a great number of patients. They flock to a European doctor. There are two hospitals: an out-patient or general hospital, which is in a large building adjoining the government offices, and an in-patient or military hospital, which is in the cantonment of Sherpur. This cantonment, you will remember, is the fortified enclosure that was held successfully in the winter of 1879 by Lord Roberts, with a small force, against the combined rush, one night, of the whole Afghan army, 20,000.

After a month, a message arrived from the Amir that I was to join him in Turkestan. The treasury officer was also going with a supply of rupees from the treasury. I joined him, and we started with a large guard of cavalry on May 16. Mr. Pyne and the two assistant engineers remained in Kabul. One night we camped on the Hindoo Koosh mountains. We had been riding for

hours along the mountain paths, and then camped on sloppy melting snow. My tent had not arrived, so the treasury officer invited me into his. I took off my ulster, which was soaked with wet, lit a pipe, and sat on a camp stool (with nothing to lean against), shivered aloud, and wondered why I was born. Presently, Jan Mahomed, the treasury officer, noticed that I seemed uncomfortable. He very courteously rose, took the big sheepskin posteen off his own shoulders, and placed it round mine. I tried to refuse; we neither of us could speak a word of the other's language, but he insisted. A soldier brought him a cloak, which he threw round him. Then they brought an iron pot into the tent, and, after considerable trouble, lit a wood fire, piling it up with damp sticks. The smoke was awful; no one seemed to mind it but me; my eyes smarted and streamed with tears. At last I had to sit and smoke with my eyes shut. I got warm eventually. We had camped near a Hazara village, but the villagers were so poor, that not a scrap of food was to be had. At last a few pints of milk were obtained; it was put into a pot over the fire, some water added, and a handful of tea thrown in, and the whole boiled. Jan Mahomed and I (because I was a guest) had two tea-cup fulls; the others one: this was our dinner. My bedding had not arrived, so some straw was put on the ground, then a carpet. I spread my waterproof sheet, rolled my coat up for a pillow, wrapped the posteen round me, and went to sleep. It was very uncomfortable. However, no evil resulted, except that my interpreter had an attack of fever that night.

It was rather a trying journey. We made long marches, and as soon as we halted, I used to lie on the ground, and go to sleep at once. One time you would be crunching through the snow; an hour after, you would be riding through a valley where sunstroke was a possibility. About half way on the journey was the Bamian Valley. It was to this valley that Lady Sale, and the other English ladies taken prisoners in the first Afghan war, were conducted. Happily, it is a matter of history that they were brought back in safety. In this valley, cut out of the face of the mountain, are three colossal figures, a male, a female, and a smaller one, said to be a child. These are considered to be ancient Buddhist idols, and the caves in the rocks by the side of them temples and dwelling-places for the priests. On the mountains, the other side of the valley, is an ancient Persian city, deserted. One comes across two or three of these deserted cities on

the road to Turkestan; whether they are all Persian, I cannot say. The Afghans say they are cities built by "Sekunder" or Alexander. The road is mountainous as far as Tash-Kurgan, or Khulm. We had a few dangers. Where the path was broken away, we scrambled across on foot, the soldiers bringing the horses. Also, in crossing a mountain, called the "Tooth-breaker." You ride along smooth stone, slanting to a precipice of unknown depth, and descend a zigzag path of smooth slabs tilted in every direction. However, the Kabul horses are very clever climbers, and as hard as nails. At Khulm the road was washed away, and we had to ford three times a torrent, fortunately shallow, which was roaring at the bottom of the ravine. Then we got out into the open; the mountains ended. It was undulating ground, like downs, with scrubby grass for some miles, and then flat dusty plain right up to the town of Mazar-i-Sherif, where the Amir was encamped. We did the journey from Tash-Kurgan to Mazar in the day—nearly forty miles. It was intensely hot. We stopped four or five times while the servants boiled some water and made tea, and once we stopped at a Turkoman camp and had tea in a wigwam, or *khirgar*. At last we reached Mazar, crowds of people coming to meet us. The house that was given to me was historic. It was the royal residence before the Amir built his present Turkestan palace. Amir Shere Ali lived there, and, indeed, died there, in the room that I occupied. It is a well-built house, situated in a walled garden, which is full of flowers and trees. It is raised three or four steps above the earth, is one story high, and has inner and outer rooms. It has coloured glass windows, draped ceilings, white walls covered with sparkling particles of talc, and the rooms were carpeted all over with the beautiful Turkestan rugs.

I was allowed to rest for a day, and on May 30th was taken to the palace and introduced to his Highness. The palace is situated in the midst of a very large walled garden, full of almond trees and flowers. It is just like a well-built bungalow, such as you see in India. Mazar-i-Sherif is exceedingly hot in the summer, and his Highness was seated in an armchair in the verandah, holding his *durbar*. Running across the garden, and in front of the palace, is a stream of water, three or four feet wide. The Amir, with the chief officials, the pages, and the guard, were on the palace side of the stream; the other people attending the *durbar* were on the

further side. Every one was standing excepting the Amir. When I was introduced, I took off my sun-helmet and bowed in the European way; then I was taken across the stream, and a chair was given me. The Amir spoke to me for some minutes, making the usual polite inquiries as to my health, and he hoped I was not fatigued.

His Highness is a man of presence, broad, and stout; he is fair-skinned, sunburnt, with black hair and beard; he has a good square head and piercing eyes. He was dressed as a European in semi-military costume. His manner is dignified and courteous; he can, however, if occasion arises be exceedingly fierce; not the most powerful Afghan chief dare come near to him uninvited, nor does he speak, or sit, in the Amir's presence without permission.

I soon got to work in Turkestan. I found remittent fever was simply decimating the troops. The mode of treating the disease adopted by the native physicians, or *hakims*, was irrational and most unsuccessful, so that I had six months' very hard work all through the intense heat of the summer. There was a man named Allah Nûr whom I found with disease of the elbow joint. It was incurable, and I said the arm must come off. Allah Nûr, though he was very ill, was alarmed at this. He made his escape from the hospital, got on a donkey and had reached a place called Takhtapul about seven miles away before he was captured. They took him before the Amir. His Highness called for a probe, examined the joint and said "Decidedly the arm must come off." The man fell on his knees and said, "For God's sake, no." The Amir reached out his hand and boxed his ears. Then he sent for me and advised me before I operated to give the man port wine, and to feed him up as he was weak. The advice was good: but the next day I found the flies had got to the joint, and I amputated the arm at once. The patient recovered rapidly, the wound healing in eight days. I took him before the Amir and received his Highness's congratulations. This was my first surgical operation in the country.

The summer coming on, I had to go to the hospital at daybreak to escape the heat. The hospital, by the way, was a large garden or orchard, and the patients had beds under the trees, or, when we were very crowded, they lay on the grass. The climate is exceedingly hot, and there is no dew. At the end of the summer I got the fever, and was ill for some time. The

Amir was exceedingly kind. Hearing that I did not care for the food I could get, he ordered anything I fancied to be sent from his own kitchen; and, as he had an excellent cook (a Hindustani), I did exceedingly well. I had beef tea, jellies, puddings, port wine, fruit and so on. He paid me a royal visit by deputy, sending his chief secretary (he has no ministers), and finally presented me with the Izzat medal for the work I had done among the soldiers. It is somewhat of a curiosity, inasmuch as it is the only one of the kind that has been struck.

On September 15th, 1889, the youngest son of the Amir was born—Prince Mahomed Omer. According to Afghan custom he is the rightful heir to the throne. He is of royal blood on both sides. His mother, the Sultana (or chief Queen) being the Amir's cousin. Prince Mahomed Omer is a bright-eyed youngster, singularly like the Amir in appearance and in his way of speaking. His Highness says the boy has the "royal manner." Prince Habibullah, the eldest son, who is about 24, is an intelligent man of a kindly temper. He governed Kabul for two years while the Amir was in Turkestan. It was an important and difficult post, and I have heard that the people were delighted with his just and mild rule. He is, however, somewhat of a weak character, and is easily led by favourites; and, unfortunately, he stammers in his speech. The Sultana, on the other hand, is a determined woman of very strong character.

I got rid of my fever on Christmas-day. I was called then to see one of the page-boys. I found him living in a Turkoman khirgar, in the palace gardens. His horse had dashed him against a tree and broken his thigh. While I was setting the thigh, I noticed the scar of a bullet. Inquiring the cause, I heard the story of an attempt on the life of the Amir which took place the year before. The Amir, they said, was seated in an arm-chair out on the plains, reviewing the troops. As a Herati regiment was passing, one man stepped out from the ranks and fired at the Amir. The bullet was well aimed, but, just as the man fired, the Amir, who was smoking a cigarette, leaned over to speak to someone who was sitting on the ground by his side. The bullet went under the Amir's arm, through the back of the chair, and into the thigh of the page-boy. The Amir did not stop smoking his cigarette, and he finished what he had to say. They rushed up to cut the

man down, then the Amir shouted to them to stop; too late, however, and the man was killed before he could say anything. The Amir wanted to get to the reason of it all. He could not see why a private soldier should want to assassinate him. He never got to the root of the matter, but he dealt with the officers of the regiment very severely.

After I had set the boy's thigh, I went on to the durbar (or reception) at the palace. The Amir congratulated me on my recovery, and when the durbar was over, invited me to lunch with him: this was about midday. His Highness had a table to himself, and I a small table in front of him; the other officials sat on the ground. The lunch was cooked in the native style, and consisted of pilau, stews of various kinds, hard-boiled eggs, puddings, cheese, and fruit. A sirdar, or noble of the Amir's tribe, waited upon his Highness, and, on this occasion, also upon me. The Amir made some polite and complimentary speeches to me, and asked me to vaccinate the little prince, Mahomed Omer, as soon as he was old enough.

A day or two afterwards the Amir caught a severe cold. I was sent for, and spent several hours daily at the palace, lunching and dining with his Highness. I got to know him much more thoroughly than I had done before. I found him a well-informed and most entertaining man. He sat on a charpoy, or couch, wrapped in a gorgeous silk robe, with a small white turban on. Pages with velvet and gold tunics were grouped about; a few of the chief officials were seated on the ground round the room. I had a chair, and sat smoking cigarettes, while the Amir told me stories of his adventures in Russia when he was in exile; told me of the new Kabul that he hoped to build; the action of native drugs; the customs of Afghan hillmen. Then he widened his field, and discoursed upon all sorts of subjects—some of them, I confess, he had but a superficial knowledge of, and of some he had no knowledge. But he spoke with such courtesy and dignity that it was impossible to do other than agree with him, whatever statement he made. His people were profoundly impressed at the extent of his knowledge. It seemed to me that this was what he was aiming at. One custom he has, which strikes one at first as unusual; it is that he takes out his artificial teeth in open durbar, cleans them with a tooth-brush, and then replaces them—all his teeth are false. But on thinking of a reason for this

custom, one sees it is simply a part of the plan to impress his people. They, especially the villagers and hillmen, are profoundly ignorant; they do not know that there are such things as false teeth in existence, and when they see before them a king who can take himself to pieces, they stand aghast. I think, too, this wish to impress his people is one reason why he is fond of employing Europeans. He says: "These Feringhis, who possess all the knowledge and all the wealth of the world, they are *my* servants—the servants of your king."

And the machinery. The people call the workshops "en-gin" (a "gin" in Persian means a "devil"); and they see these horrible-shaped things, which make cartridges and money, sometimes clutch hold of a man, and break his bones, or kill him. And they are profoundly impressed at the power of the great king whose servants these monsters are.

One of the ways in which the Amir's taxes are gathered is ingenious, and essentially Oriental. A court official is made governor of some place, on a small salary—£10 or £15 a month—but presently he blossoms out into a sort of small Rajah. He heaps up wealth, keeps a crowd of servants and horses, and dresses in velvet and gold. This goes on for a year or two, then he is re-called to Kabul, to make out a statement of his accounts. His ill-gotten wealth is put in the treasury; his finery, and the shawls and diamonds of his wives in the Government stores; and he is punished severely for oppressing the people; and so every one is satisfied. His Highness has some wonderful and valuable things in his stores: beautiful vases, diamonds, and shawls, and many things you would not expect, for instance, a telephone and a tricycle. One evening, when he was telling me stories, I stuck my pocket-knife into the stump of my cigar to hold it. The Amir asked, Hadn't I a cigar-holder? I said, "No." His Highness spoke to a page boy, who presently returned with about a dozen cases. The Amir chose two, which he gave me, meerschaum and amber.

One morning, in the winter, I was called at 6 o'clock to vaccinate the little prince. Why they wished it done before daylight, I do not know. The servants got me some tea ready, and I started, accompanied by one of the chief hakims. The prince was not in the harem, but in his own house. He was four months' old, but he had his house, his wives, horses, and signet. Infant marriages are not the custom in Afghanistan; these were "politi-

cal" wives. We passed the sentry at the gate, walked across a square garden to the house. There were no flowers in the garden; it was January, and there was snow on the ground. Mazar, though intensely hot in the summer, is equally cold in the winter. In the room, which was carpeted and curtained, was another hakim, or physician, a very aged man, and also a young nurse and two old ones. These ladies, contrary to the Mahommedan custom, were not veiled; the younger one was nursing the little prince. He was a healthy-looking baby, with dark eyes and hair, and a fair skin. The nurse, too, was fair skinned. She was dressed in loose Oriental trousers, a long white vest or robe, reaching below the knee, a little crimson jacket, and a round embroidered cap, like a polo cap, put a little on one side of her head; and she had a Cashmere shawl over her shoulders. She asked my interpreter to inquire if there were any women in England as beautiful as she! The old ladies rebuked her. I had no trouble in vaccinating the little prince, and in a day or two we became excellent friends. He would sit on my knee or let me carry him about the room. One day I remember he was laughing as I said good bye. Immediately one of the old ladies followed me out and begged a hair from my head—so that no evil should result from my having left him while he was laughing. The hair was burnt with due ceremony. At this time I had to vaccinate also all the little page-boys or slaves who were to be the prince's attendants. The slaves in Kabul are simply prisoners, taken when some rebellious tribe goes to war with the Amir. As a rule they are treated exceedingly well. Sometimes you cannot tell which is a man's slave and which is his son. The Amir has placed several of his favourite slaves into positions of great trust.

As my professional work became less severe, I amused myself by painting the portrait of my next-door neighbour, one of the chamberlains, and I painted my own portrait. The Amir hearing of it sent for the pictures. He approved of them, and then requested me to paint his portrait. On January 24th I began it. The studio was simply the durbar-hall at the palace, and I had to take the light as it came. The Amir was an excellent sitter. When I began the portrait I had a crowd of officers, secretaries, and pages around me. After a sitting or two, when the novelty wore off, some of them began to offer criticisms. The Amir told them to talk about things they

understood and not to make fools of themselves before an Englishman. The likeness was satisfactory, and one day I sent for the painting to my house to varnish it. There were some patients waiting (soldiers and peasants). When the portrait was being carried in they all rose and salaamed; they did not know what a painting was.

Near me lived another of the Amir's sons, little Prince Hafiz Ullah. He was a fair-haired youngster of about ten. I often went and had a cup of tea and a chat with him and his tutor. One day he took me with him to see some wrestling matches between the Mazaris and the Turkomans; the wrestling was to take place in a large garden or park called Charbagh. The prince was carried in his little palanquin, or chair, and I walked by the side. A guard of soldiers marched in front and behind. The people in the bazaars salaamed as we went by. There is no shouting in the East on these occasions. We passed the great mosque or Mazar, from which Mazar-i-Sherif takes its name. It is a big building, with a domed roof decorated with blue tiles. In it is a tomb, said by the Afghans to be the tomb of Ali, son-in-law of the Prophet. In the Charbagh a large, open space was prepared, with a raised platform at one end. Here, under an awning, sat the prince, some officers, and myself, the attendants standing behind. The open space was surrounded by crowds of Orientals in their turbans and gay-coloured dresses. Before the wrestling began, there was a dance by the soldiers of a Kandahari regiment. In the centre sat the musicians playing their native instruments—drums, and a sort of flageolet, which gave a sound resembling that of the bagpipes. The rhythm of the music was curious, quite different from that of European music. The soldiers formed a ring, and started with a slow step, something like a mazurka step, singing a chant in unison; presently they went quicker and quicker, and seemed to work up at last to a pitch of frenzied excitement, uttering sharp yells, and whirling themselves round. It was a striking, and really quite a stirring sight. Then the wrestlers came on. They were barefooted, had a long, loose coat, unfastened, with sleeves, and a skull cap. They faced each other and warily sidled round and round. Suddenly they rushed forward, each seizing the other by the elbow and collar, and the wrestling began in earnest. It was necessary for one to throw the other so that both shoulder blades were touching the ground

before he could be considered conqueror. The Turkomans were immensely strong men, and none of the Mazaris could stand against them. The prince, therefore, pitted the Turkomans one against the other, and the wrestling grew more interesting. Before the prizes were distributed, the Kabulis gave a display of their style of wrestling. They were nearly nude—had simply a waist cloth. How they grasped each other I cannot tell you. It was very quick and very pretty wrestling, but it was play—they did not compete. They offered to wrestle the Turkomans in the Kabuli fashion, but the Turkomans said, "No, we will wrestle you our way;" so nothing came of it. The prince distributed the prizes to the winners. They were long coats of bright colours, such as Turkomans and Mazaris wear. Then tea was brought us, bands played, and we went off home again.

One day my interpreter took me into my next-door neighbour's for a game of cards. I found one of the page-boys there. He was studying Euclid. However, he gave up his book readily enough to help teach me cards. They played a sort of three-handed whist without dummy. I learnt the game, but I have forgotten now how it was played. The cards they used were precisely the same as ours—they were made in Germany.

On June 13, 1890, his Highness left Turkestan, and started with the army, the Court, and all of us for Kabul. We camped the first day on the plains a few miles from Mazar. The heat was intense. They gave me a little iron chair to sit on while my tent was being put up, but the chair became so hot that I had to stand. There did not seem to be a breath of wind. I was the only European in the camp, and I thought I should certainly get sunstroke. At last my tent was up; but being put up on the hot earth about midday, it was like an oven. The Amir sent me some ice pudding; I ate it quickly before it was all melted, and lay and gasped on my charpoy or bedstead. I tried to read Shakespeare, but it did not seem very interesting.

After that we travelled at midnight to avoid the heat. It was pitch dark—there was no moon—and some of us lost our way on the plains. At dawn one day the Amir found himself wandering off towards Russia. We had all sorts of adventures, which seem amusing enough to look back on, but were anything but amusing at the time. One night we had been riding and riding till I was thoroughly tired. I turned round to grow

at my interpreter, and found that he and I and a soldier were alone. I refused to go any further, so we got off our horses. We found a stream or a ditch of some kind, scooped some water up, and drank it. I do not know if it was muddy or not; we could not see. I think we should have drunk it if it had been poison; we were so thirsty. We lay on the ground and went to sleep, the soldier holding the horses. I rolled my revolver up in a mackintosh and used that for a pillow. I was woke up suddenly by hearing a terrific scream. It was daybreak. A lot of soldiers who had followed us were lying around, and two horses were fighting furiously; they were screaming, and biting, and striking each other with their fore feet. It is astonishing what a huge animal a horse looks when he is standing upright on his hind legs and you are lying on the ground. We soon jumped up and got out of the way. Then we rode on till we found the camp.

We stopped some days at a place called Haibuk, and I became ill. One day I went to see his Highness, and he said he should like to prescribe for me. He was seated under an awning, which was put up near some trees in an open space surrounded by corn-fields. I thanked his Highness for the offer, and he spoke to a hakim, who presently returned with a small jar, containing a confection. His Highness took a little silver spoon, dipped it into the jar, and was raising it to his lips, when the hakim stopped him, and whispered something in his ear. The Amir turned and looked at him. The hakim hurried out with a very red face, and presently returned. Again the Amir took a spoon, and this time he ate some of the medicine. Then he immediately put the jar into the hands of my interpreter, who gave it to me. In the East it is the custom for a physician to taste the medicine before he gives it to the king, not for the king to taste a medicine before he gives it to his servant. I can never forget the Amir's courtesy—and more than courtesy, his care of me—on this occasion. We started on our march again, and the Amir sent me his elephant to ride. I was rocked along in the early morning before the troops started. Among so many thousand people there were, of course, many accidents among the mountains. There were seven or eight elephants, and many thousand horses and camels. The elephants were rather a nuisance to the army, they went so slowly. They would block up a pass, so that the soldiers

would have to sit for a couple of hours or so in a small valley, jammed in among kicking and screaming horses. Some of them had their legs broken. The Amir and his guard started some hours after everyone had gone on. The Sultana, the little princes, and the harem were a day in front of us. Before we reached Kabul the Amir sent me his palanquin to ride—the bearers scuffled along at a great pace. When the Amir rides in his palanquin he always takes a walking-stick with him, and if the bearers do not go fast enough he prods them in the back with his stick. We arrived at Kabul on July 24th, the journey taking 40 days.

The formal reception of the Amir was at a place called Baghi Buland, a few miles from Kabul. It is a hill covered with vines, fruit trees, and flowers. A pavilion was erected there. The two eldest princes, who had remained in Kabul, came and kissed the Amir's feet, and all the chief officials who had been in Kabul also came to salaam his Highness. A salute of guns was fired, and the Kabul troops paraded. I did not wait till the end of the ceremony, but was carried on to the house the Amir had selected for me in the city.

I got better in the autumn, and then the Amir was taken ill. I was called to see him on December 2, at nine o'clock in the evening. The Amir was exceedingly ill. He had had gout for some time, and the hakim had not only put his foot into ice and water, but had bled and leeches him till his life was in great danger. I did not leave his Highness for five days and nights. His condition improved under European treatment. After that I had rooms given me in the princes' quarters, and visited the Amir two or three times a day. Just then the Sultana was taken ill, and the Amir ordered me to attend her in the harem. I was conducted through the great double gates, through a portico, into a paved quadrangle, with large white buildings all round. No one was to be seen except the old man who led me in. I was taken up some steps into an ante-room, curtained and carpeted, but with no furniture. Then up some more steps, into a large, high room. This was well furnished, very much in European fashion, chairs and tables, china vases and ornaments, candleabra, curtains, and so on. Across one end of the room there was stretched a thin, crimson silk curtain. One or two little page-boys, aged about nine or ten, were in the room. When I entered, a voice from behind the curtain bade me welcome; it was the Sultana

speaking. I bowed, and went forward, answering her Highness in Persian. A chair and a small table were placed, and tea and cigarettes brought. I made inquiries as to the health of her Highness, examined the pulse, her Highness raising the curtain sufficiently to put her hand through. I noticed that the hand was very white, and was that of a young woman. I gave her the clinical thermometer, and found she had considerable fever. After staying a short time, I asked permission to retire, then bowed and left. I had to visit her several times during the next few days. Her Highness showed me her album of photographs, her hats and bonnets, which were English, and two or three gorgeous crowns of beaten gold, set with great yellow diamonds. Among her hats, I remember, was one of sealskin, trimmed with a squirrel's tail, and round it was fastened a wreath of artificial flowers. I suggested that flowers grew in the summer, and that fur was worn in the winter; perhaps it would look better without the flowers. She tore them out at once.

The Sultana recovered, and the Amir also. I was treated with great kindness, and received valuable presents from both of them.

When the spring came, I left the palace, and went back to my house. The Amir requested me to paint the portraits of the two eldest princes. When they were finished, I left Kabul for England, on some months' leave of absence. On my return in the beginning of 1892, the Amir received me most kindly. He was living then at his palace, at Endekki, five or six miles from Kabul. The palace is built on a small hill, and has a beautiful view across the Charbagh valley. It is something in the style of a Grecian temple, oblong, with a row of pillars on each side. It is furnished in European style. A few days afterwards I went to visit Prince Habibullah, who was living in a garden called Baber Badshah. The garden is enclosed by a very high wall, and is on the slope of the Sher Derwaza mountains just outside Kabul. In it is the tomb of the great King Baber, founder of the Moghul Empire in India. The Prince was holding a Durbar when I arrived, but he postponed it, and talked to me pleasantly for some time, asking me many questions about London.

Soon after this, on April 15, cholera broke out in the city and spread rapidly. His Highness and the Court moved off to the royal summer residence in the Paghman mountains, about 15 or 16 miles from Kabul. Here the water supply is excellent. In Kabul the

drinking water is obtained from the Kabul river, which dwindles to a mere thread in the summer and autumn, and from wells sunk in the malarious, water-logged soil of the city, which is soaked with generations of sewage. The wonder is not that cholera visits Kabul, but that it ever leaves it. The mortality was excessive. I am, however, glad to say that none of the small English colony contracted the disease: they adopted the precautions which one advised. There were several Englishmen who entered the Amir's service just about that time. A tailor had come out the year before. There was Mr. Arthur Collins, the geologist and mining engineer, from whose photographs many of my slides were prepared, an assistant miner, a manager for the Amir's horse-breeding establishment, three assistant engineers, a gardener, a tanner, a currier, and a lapidary.

As the cholera became worse the native workmen in the Amir's workshops were constantly falling down with the disease, and work had to be stopped. Naturally, I had a great deal to do at this time. After a while work commenced again, but the cholera lingered on till the autumn.

At one time or other most of the Englishmen became ill, with fever or other complaints. They were not very comfortable, chiefly on account of the passive obstruction of the native officials, so that the majority of them became disgusted and did not stay long in the service.

In November I was sent for to Paghman to paint the portrait of little Prince Mahommed Omer, who was four years old. It was cold in the mountains, and I lived in a Turkestan khirgar. This was covered with felt and a waterproof cloth; tiles were laid on the ground inside, and carpets spread over them. To keep off any draught a carpet was hung over the doorway. A big charcoal brazier kept the place warm, and although the snow lay deep outside, I found it very cosy and comfortable. In the mornings the prince, with his tutor and pages, came to give me sittings. The light was arranged by raising a circular disc at the top of the dome of the khirgar. The prince was a merry little fellow. He could not understand why I should sit with my hat off, unless I had a headache, and he insisted on my putting it on. He had to be painted with a page-boy on each side of him, and one day he asked me which of the boys I should like. There were several others also to choose from, and I was to take the one I

liked best. It was rather an embarrassing offer. If I refused it would be considered a slight to the prince, and yet what was I to do with a small slave boy. My interpreter said, "Take one and pass him on to me," I did not quite see the force of that, so I thanked the prince and told him I would consider the matter, and let him know which I liked in the course of a day or two—guessing he would forget all about it by then, which, indeed, he did.

On December 1, the Amir and the Court returned to Kabul; the cholera had died out and the winter had come. I prepared a careful paper on the best means of preventing a return of cholera, and sent it to the "Court Interpreter" for translation. I heard no more about it, so I suppose the interpreter was "busy." He usually was if there were any work to be done. A few days later, December 23, I was sent for by his Highness to do some more painting. This time it was to be several large landscapes. Naturally, these different painting commissions interfered considerably with my professional work, so that I had very little time except for the more important surgical operations. I was also desired by his Highness to teach portrait painting to the chief native artists. The men—there were five of them—came to my house daily, and I put one of the servants, or one of the soldiers of my guard, to sit for them. They improved considerably, and one of them showed marked talent as a draughtsman. I should have liked to have gone on further with him. The landscapes—there were nine of them—took some time to paint. They were finished in May. Then his Highness kindly granted me some months' leave of absence. My health, however, had suffered considerably during my stay in Afghanistan—from remittent fever, and so on, and family considerations decided me in resigning, so that I left his Highness's service and returned home last summer.

DISCUSSION.

The CHAIRMAN said Mr. Gray, assisted by the very beautiful photographs he had shown, had given a most interesting account of the country and peoples of Afghanistan, the Court at Kabul, and the personality of the remarkable man who ruled that country. Since the last Afghan war, Afghanistan had been almost a *terra incognita* to our countrymen; but thanks to the small group of Englishmen who had lately entered the service of the Amir, of whom Mr. Gray

was one, and Mr. Pyne, superintendent of the workshops, who, for his great services, had been decorated by the Crown, was another, they were now getting to know more about the life in the capital, and the character of its sovereign. It appeared to him that the Amir was the most remarkable reigning potentate in Asia; for, though his country was but a small one upon the map, its population relatively inconsiderable, and its power not great, it possessed a ruler of no mean order. The grandson of Dost Mohammed, he seemed to reproduce some of the strongest characteristics of his grandfather. He was a man of great personal courage, of iron will, of inflexible persistency of purpose; and not only had he these moral qualities, but his intellectual powers were considerable. He was told, by those who had come in contact with the Amir, that he was gifted with rapid and sound intuition, great knowledge of men—particularly of the singularly unattractive people whom he ruled—and had a very creditable familiarity with general history and knowledge; whilst his sentiments—especially for a Mussulman ruler of an Asiatic state—must be called extraordinarily liberal. He had had a most remarkable career; his early history might be called a romance; and it was understood that he liked nothing better than to narrate adventurous incidents in his earlier life, now a prince in his native country, now an exile, now on the pinnacle of power, and again in the depths of despair. It was now fourteen years since (after the last war) he was put upon the throne by the British, and from that time he had not had an idle moment. It had been a period of incessant activity, and almost one of incessant fighting; rebellion after rebellion had arisen among the discordant elements of his kingdom, which had been mercilessly but successfully crushed; and at the present moment the Amir might claim for himself the credit of ruling a larger Afghanistan than had been governed by any sovereign of that country since the days of Ahmed Shah Durani in the last century. Simultaneously with this, he was doing a great deal to beautify his capital, which, at the present moment, was in a better condition than it had been at any period since the time of the Emperor Baber. At the same time he had overcome the natural suspicions of an Eastern against the mechanical inventions of the West, and had installed, either at Kabul or in the immediate neighbourhood, the workshops and factories of which they had heard, which produced for him and his army the most important inventions of modern science. This was a remarkable record, and it differed from any analogous case amongst Asiatic sovereigns, for this reason, that Afghanistan was not ethnologically, geographically, or politically a single country. Its people had little unity or cohesion; they were a congeries of different and, in some cases, highly turbulent clans. In the north-west, for instance, Herat was a Persian city, held for the Amir by an Afghan garrison. Towards the south-west he had, at Kandahar, a totally different and a more attractive population. In the heart of the country there were the

Hazaras, Tartar in origin, a people who for years past had been fighting with the Amir. Adjoining them, again, were the Ghilzais, perhaps an even more stubborn race, who also had been engaged in constant rebellion; then came the Afghans proper; and further north, along the southern bank of the Oxus, the entirely different element of Uzbek Tartars, identical in origin, sentiment, and sympathy with the people of Bokhara. The achievement of welding all these tribes into a single whole was one which stood quite apart in the history of Asia during the last 50 years. No doubt, their ideas about Afghanistan were mainly derived from historic recollection. We had entered the country and left it as conquerors, but we had also experienced there great humiliations and sometimes serious reverses. Yet he ventured to think now that this epoch was over there was not one who would say that the memory of those disasters was not wiped out from our own recollection, and we could now say with perfect truth that there was no desire to annex one yard of the Amir's dominions, but that we were the friends of an independent Afghanistan. We had already gone a long way towards guaranteeing its territorial integrity, and in the shape of the subsidy which we allowed the Amir, and the material and munitions of war supplied to him, we were giving him the means of acquiring for his country a consistency and power which no one would be better pleased to see than ourselves. The stronger Afghanistan became, the more welcome it would be to the British Government. Of course, it would be idle to deny that the political stability of Afghanistan was threatened by certain dangers. Upon the northern side of the country overhung the shadow of the great power which had made such wonderful strides in Asia during the last 50 years, and which, however friendly might be the relations which existed between us, must, at any rate, be regarded with thoughtful consideration. Then there was the health of the Amir himself, which, though no doubt it had profited by the careful treatment of his physician, Mr. Gray, had been from time to time a serious anxiety, and was a factor in the political situation not to be lost sight of. Finally, there was the attitude of the army, which had always to be taken into consideration, though matters were for the present satisfactory. There was in each of these three factors the contingency of possible danger in the future, but the fact that these dangers overhung the country made it all the more obvious that the more cordial the relations between the Amir and the Indian Government were, the more likely was he, as long as he lived, and his country afterwards, to be able to surmount those perils. He could not conclude without referring to the eminent services rendered to this common understanding between the two countries by the mission, under Sir Mortimer Durand, recently sent up to Kabul. It reflected the greatest credit on the tact and ability of Sir Mortimer Durand himself, who was greatly

aided by Mr. Pyne at Kabul. They must not forget either the Viceroy to whom the inception of the policy was due, and who in leaving India, after a career of five years, might look back on the conclusion of this agreement with the Amir as the satisfactory coping-stone of his Indian administration. Of course, it must not be supposed that because an English envoy had gone safely to Kabul and made an agreement with the Amir, therefore the Afghan's feeling towards ourselves had been turned into love. Anyone who advanced such a proposition would show great ignorance of the Asiatic character. The Afghan was suspicious and shared the dislike of foreigners common to all Asiatics, and generally more strongly shown by those professing the Mohammedan creed. But the way to get at any Asiatic people was to get at the Court first, and the fact of having won the confidence of the Amir was a stepping-stone towards better relations in the future with his people. There were other results which he hoped they would not be too sanguine in expecting to follow before long from this mission. Nothing would give greater pleasure to Englishmen and the British Government than that the Amir, if possible, or, if not himself, one of his sons should visit England. It was known that such an idea had entered his mind, and nothing could produce such an effect in cementing harmonious relations, not merely between the two Governments, but between the two peoples, as the fact of the Amir coming over to England as the honoured guest of the Crown, and becoming acquainted not only with the outward symbols of British power, but with the policy and character of our statesmen, and the feeling entertained towards him by the British public. Another consequence might, perhaps, be looked forward to in the more distant future. It must have been a source of great surprise and regret to Englishmen that, for a long time past, no communication whatever had been possible between the two dominions, and it might be hoped in time that the passage of Englishmen into Afghanistan, and mutual intercourse between the two on peaceful lines, might become possible. Finally, improved relations should result in some abatement in the stringency of the Amir's fiscal policy, whereby undoubtedly Indian trade interests had suffered, and, to a large degree the transit trade which formerly existed had been checked. If these advantages were to be obtained, some share of the credit, at least, would be due to those gentlemen—of whom Mr. Gray was one—who by their presence at Kabul during these early years had taught the Amir what was the character of British feeling towards him, and the sentiments by which we were animated.

Sir ALFRED LYALL, K.C.B., K.C.I.E., said Mr. Gray had had an almost unique experience, for very few European gentlemen had been able to get such a glimpse of this extraordinary country, and the private life of an Eastern king. His experience afforded

another instance of what was well known, the enormous use that medical skill and science was in promoting sympathetic relations between Europeans and Orientals. A medical man could set aside politics and religion, and establish himself in communication with the people of the country in a way which no one else could. It was a remarkable fact that they should be that evening in the centre of London, listening with interest to an account of a wild country in the centre of Asia. Could there be a stronger instance of the immense width of the English dominion and English interests? We had very strong interests in Afghanistan; it was not exactly within our frontiers; but its frontiers we had undertaken to protect, the line having been laid down by agreement between the two great European powers, which were both making for themselves empires in Asia—England and Russia. It was for that reason that those who sat at home, safe behind their sea-washed barriers, were responsible for the maintenance of the frontier, and the welfare of people at such a distance. There was no doubt the Amir was one of the most powerful and successful monarchs, perhaps, in Asia, and his was one of those curious kingdoms which had been left standing, notwithstanding the agglomerations of the great empires of Russia, China, Persia, and India. The people of Afghanistan were an agglomeration of tribes, but beyond that they were an assemblage of free men who, like ourselves, considered liberty one of the noblest gifts. They had always fought gallantly against the foreigner, and were determined, if possible, to have their country for themselves. We could all sympathise with people of that sort, and for that reason he cordially echoed the wish the Chairman had expressed that we should use every exertion to preserve the liberties of the Afghan people, and maintain its independence and integrity.

Colonel E. T. THACKERAY, R.E., C.B., V.C., said, one interesting feature of Afghanistan was the system of subterranean canals, or underground channels, which were made for connecting together the shafts sunk wherever water was expected to be found. Some of these canals were carried to a length of about 20 miles. These canals were supposed to have been originated by King Hushung, who was also supposed to have built the seven great cities of Afghanistan, besides Kabul. Earthquakes were extremely common in that country.

A vote of thanks to Mr. Gray for his interesting paper was carried unanimously, and briefly acknowledged.

FOREIGN & COLONIAL SECTION.

Tuesday, February 20, 1894; Sir ALBERT KAYE ROLLIT, LL.D., M.P., Vice-President of the Society, in the chair.

The paper read was "The Arts and Industries of Belgium, and the Antwerp Exhibition, 1894," by Edouard Sève.

The paper and discussion will be printed in the next number of the *Journal*.

TWELFTH ORDINARY MEETING.

Wednesday, Feb. 21, 1894; Sir RICHARD WEBSTER, Q.C., M.P., Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Kent, Walter G., 199, High Holborn, W.C.
 Niven, David Coats, Oriental Gas Company, Calcutta.
 Walker, Ernest Octavius, C.I.E., Brook-hill-house, Teignmouth, Devon.
 Walton, Joseph, Zetland-buildings, Middlesbrough.
 Williamson, G. H., Mayor of Worcester.

The following candidate was balloted for and duly elected a member of the Society:—

Bruff, Charles Clarke, Coalport, Shropshire.

The paper read was—

ELECTRIC SIGNALLING WITHOUT WIRES.

BY W. H. PREECE, C.B., F.R.S.

What is electricity? Few venture to reply boldly to this question, first, because they do not know; secondly, because they do not agree with their neighbours, even if they think they know; thirdly, because their neighbours do not agree among themselves, even as to what to apply the term. The physicist applies it to one thing, the engineer to another. The former regards his electricity as a form of ether, the latter as a form of energy. I cannot grasp the concept of the physicist, but electricity as a form of energy is to me a concrete fact. The electricity of the engineer is something that is generated and supplied, transformed and utilised, economised and wasted, meted out and paid for. It produces motion of matter, heat, light, chemical decomposition, and sound; while these effects are reversible, sound, chemical decomposition, light, heat, and motion reproduce those effects which are called electricity.

Faraday's immortal researches, Clerk-Maxwell's prophetic investigations, and Hertz's convincing experiments, have definitely and conclusively proved the existence of one medium throughout all space, called the

ether, through which waves of energy, called radiations, are propagated with the same velocity, but in different forms and with different frequencies, although all of the same character. At one end of the scale we have actinic disturbances producing photographic impressions; at the other end of the scale electric waves producing electromagnetic disturbances while the intermediate radiations give light and heat. Actinic waves are extremely minute and number many millions per second, electric waves are very long and may number only hundreds per second. Like light waves, they are propagated in straight lines, they obey the laws of reflection, they are refracted, they are subject to interference, and they may be even polarised.

We have to consider electric waves to-night, and I want to show you how we are gradually, by patient plodding, creeping along towards the period when I hope we shall be able to make real practical use of such electromagnetic disturbances.

If we take a conductor through which a rapidly alternating current is being supported by any means, it throws the ether which surrounds it into oscillations. Energy is thus radiated away in electric waves. These electric waves spread out in all directions, as do waves of light, and if they fall on similar conductors properly placed and sympathetically prepared, these waves of energy are transformed back again into alternating currents which give evidence of their presence. Their presence is indicated by a telephone if the frequency of the alternating currents is brought within the range of the ear. Hertz and his followers experimented with waves of much shorter length, and with sparks in air, but all my experiments have been made with telephones and with waves comparable in frequency with those of sound.

The prime source of energy has been either a steam-engine or a galvanic battery. This has produced, by suitable machinery, rapidly intermittent or alternating currents, which have been transmitted through a primary circuit. At some distance away from this circuit there has been a secondary telephone circuit, and between these two circuits the only connecting medium has been the ether, which has been thrown into electric oscillation, and it has been across this space that I have been signalling without wires. In all cases, the primary currents were of such a frequency as to produce a musical note in the telephones fixed in the secondary circuit,

which could easily be read, if sent in the dots and dashes of the Morse code.

Signalling through space is very fascinating. I have now for ten years been steadily investigating the subject. In 1884, messages sent through insulated wires, buried in iron pipes in the streets of London, were read upon telephone circuits erected on poles 80 feet away on the housetops. It was imagined this must have been due to accidental connections, or to earths, or to any other cause but the true one, namely, electromagnetic induction, or the influence which one conductor conveying currents exercises on another parallel to it, when separated by a dielectric, or by mere space, that is, by the ether.

It is very difficult to convert the human mind from one mode of thought to another. We have been so trained to regard currents of electricity as something flowing in one complete unbroken circuit, that their temporary condition as waves of energy in space is difficult to realise. One irresistibly endeavours to trace them to earth conduction, to leakage, to contact, or to some more well-known cause. Ten years of unremitting experiment have, however, proved the effects I am bringing before you to be due, primarily, to radiation, and not to conduction.

In 1885, a very exhaustive series of experiments was made for me by Mr. A. W. Heaviside, in the neighbourhood of Newcastle, to find out how far the distance between the wires affected the results. Ordinary telegraph working currents produced disturbances at a distance of 2,000 feet, while effects on parallel lines of telegraph, $10\frac{1}{4}$ miles apart, between Durham and Darlington, were perceptible. Distinct speech was carried on through a distance of one quarter of a mile. We even obtained indications of current between the east and west coasts, 40 miles apart, but these observations were vitiated by conduction through the large network of telegraph wires between those two places. I brought the subject before the British Association at their meeting in Birmingham in 1886. The district between Gloucester and Bristol, along the banks of the River Severn, was then selected, where for a length of 14 miles, and at an average distance apart of 4.5 miles, no intermediate disturbing conductors existed. I was able to experiment with complete metallic circuits, the return wires passing far inland, in the one case through Monmouth, and, in the other, through Stroud. Weak disturbances were detected. These experiments

were repeated, with more experience and greater success, in 1889. Similar experiments were conducted along the valley of the Mersey. A new trunk line of copper wires that was being erected between London and the coast of North Wales was then experimented upon, and some interesting results were obtained in the district between Shrewsbury and Much Wenlock, and between Worcester and Bewdley.

An admirable series of experiments were made for me in the same year, by Mr. Gavey near Porthcawl, in South Wales. There we have a wide expanse of sand well covered by the tide and giving the opportunity to observe the effects in water as well as in air. Squares of insulated wire, 1,200 yards long, were laid side by side at various distances apart, and smaller squares were suspended above each other on scaffold poles. The effects were observable equally in air and water. The results were absolutely conclusive that we were working with the so-called electro-magnetic induction, and all subsequent experience has confirmed this conclusion.

These further experiments were brought before the British Association at Manchester in 1887.

Thus the theory of the thing had been thoroughly threshed out, and it only waited for some convenient opportunity to give it a practical test.

When the Royal Commission to inquire into electric communication between the shore and lighthouses and light vessels was appointed in June, 1892, the question was started. Here was the opportunity. My proposal to test this means of communication in a practical way was submitted by the Postmaster-General to the Treasury. The expenditure was sanctioned, and the experiment made. The results were submitted by me to the Electric Congress which was held in Chicago in August in 1893.

The Bristol Channel proved a very convenient locality to test the practicability of communicating across a distance of three and five miles. Two islands, the Flat Holm and the Steep Holm, lie off Penarth and Lavernock Point, near Cardiff, the former having a lighthouse upon it. On the shore two copper wires weighing 400 lbs. per mile, forming one conductor, were suspended on poles for a distance of 1,267 yards, the circuit being completed by the earth. Experience justified the assumption that the earth acts as a conductor, and that it practically replaces the fourth side of the rectangle used in the previous experiments. We have

not yet determined the actual position of the resultant line of this earth side, but further experiments are being made. On the sands at low water mark, 600 yard from this primary circuit and parallel to it, two ordinary gutta-percha covered copper wires and one bare copper wire were laid down, their ends being buried deep in the ground by means of bars driven in the sand.

One of the gutta-percha wires was lashed to an iron wire to represent a cable. These wires were periodically covered by the tide which rises here at springs to 33 feet. On the Flat Holm, 3.1 miles away, another gutta-percha covered copper wire was laid for a length of 600 yards.

There was also a small steam launch having on board several lengths of gutta-percha covered wire. One end of such a cable, half a mile long, was attached to a small buoy, which acted as a kind of float to the end, keeping the wire suspended upon or near the surface of the water while the launch slowly steamed ahead against the tide. It was paid out and picked up in several positions between the primary circuit and the islands.

The apparatus used on shore was a 2 horse-power portable Marshall's steam-engine, working a Pike and Harris's alternator, sending 192 complete alternations per second at a voltage of 150, and of any desirable strength up to a maximum of 15 ampères. These alternating currents were broken up into Morse signals by a suitable key and sent along the primary circuit. The signals received on the secondary circuit produced sound and were read on a pair of telephones—the same instruments being used for all the experiments.

The object of the experiments was not only to test the practicability of signalling between the shore and the lighthouse, but to differentiate the effects due to earth conduction from those due to electromagnetic induction, and to determine the effects in water.

It was possible to trace, without any difficulty, the region where the signals ceased to be perceptible from currents, due to earth conduction, and where they commenced to be solely due to electric waves. This was found by allowing the paid-out cable, suspended near the surface of the water, to sink. Near the shore, no difference was perceptible, whether the cable was near the surface or lying on the bottom, but a point was reached where all sounds ceased as the cable sank, but were recovered again when the cable came to the surface.

The total absence of sound in the submerged cable rather surprised me, and it leads to the conclusion, either that the waves of energy are dissipated in the sea water, or else that they are reflected away from the surface of the water like rays of light. I believe implicitly in the latter explanation. Subsequently, experiments on the sands in the Conway Estuary showing the relative transparency of air and water to these electric waves, tend to support the latter deduction, for if waste of energy took place in the water, the difference would be more marked than was actually found to be the case. It was 6 per cent. only. As it is, we have ample evidence that the electric waves are transmitted to considerable distances through water, though how far remains to be found out.

There was no difficulty in communicating between the shore and Flat Holm. Messages were read. Mr. Gavey, who was making the experiment on the island, wrote me, "There was then a somewhat lengthened pause, due to a slight derangement of the machinery on the mainland, but at 2 p.m. I heard clearly and distinctly the following, 'Here Haskayne' (one of his assistants) 'with a message from Mr. Preece for Mr. Gavey.'" I was in London that day. "Then followed the announcement of the sad and sudden death of Mr. Graves, which cast a gloom over the success of the experiment. It seemed an extraordinary fact, that the first readable message transmitted for such a distance by such means should announce the death of the head of the Technical Department."

The distance between the two places was 3.1 miles. The attempt to speak between Lavernock and Steep Holm was not so successful. The distance was 5.35 miles, but though signals were perceptible, conversation was impossible. There was distinct evidence of sound, but it was impossible to differentiate the sounds into Morse signals. We were just on the limit of audibility, and we were using our available maximum power. If either line had been longer, or the primary currents stronger, we should have spoken as was done at Flat Holm.

As the laws governing these effects were by no means so clear and conclusive as such probing and enquiring deserved, Mr. Gavey and Mr. Kempe conducted for me a very careful series of experiments near Frodsham, on the estuary of the Dee, which was found to be a more convenient locality than Conway, and the very satisfactory results obtained will

shortly be published. The conditions are now so clear that, given the localities between which it is desired to communicate, it is a mere matter of calculation to show what has to be done. It would be quite easy to speak between France and England across the Straits of Dover.

There happens to be a very convenient and accessible loch in the highlands—Loch Ness—forming part of the route of the Caledonian Canal between Inverness and Bannavie, having a line of telegraph on each side of it. Five miles on each side of this loch were taken and so arranged that any fractional length of telegraph wire on either side could be taken for trial. Ordinary, and not special apparatus was employed, sending messages, as before, by Morse signals, and speaking by telephone across a space of one and a-quarter miles was found practical, and, in fact, easy; indeed, the sounds were so loud, that they were found sufficient to form a call for attention.

The following apparatus was in use on each side of the loch for the transmission of Morse signals:—A set of batteries consisting of 100 dry cells, giving a maximum voltage of 140; a rapidly revolving rheotome which broke up the current into a musical note; a Morse key, by which these musical notes could be transformed into Morse signals; resistance coils and ampères meters to vary the primary current; two bell telephones joined in multiple arc to act as receivers. For the transmission of actual speech simple granular carbon microphones, known as the Deckert's, were used as transmitters, and a current of 2 ampères was maintained through these and two Bell telephones in circuit with the line wire.

Any lingering fear that earth conduction had principally to do with these results was removed by making the earth's terminals on the primary circuit at one end at Inverness nine miles away, and at the other end in two directions in a parallel glen about six miles away. The early experiments of 1886, in the valley of the Severn, had placed this question of earth interference beyond the region of doubt, but earth conduction, as a main factor in the results, is still believed in by critics. The function performed by the earth has been thoroughly developed in the Frodsham experiments, and will be discussed subsequently.

One very interesting fact observed at Loch Ness was that there was one particular frequency in the primary circuit that gave a decided maximum effect upon the telephones in the secondary circuit. This proves the pre-

sence of resonance, and is, of itself, a fact sufficient alone to prove the effects as being due to the transformation of electric waves into electric currents.

It is well known that every telephone has one particular note—the natural note of the disc—to which it responds better than to any other, but this resonant effect far exceeded in magnitude any difference due to the natural pitch of the disc. It was not the natural note.

Conversation by telephone, though possible, was not however practical. Still, it is something to have transmitted speech by electricity across an air space of $1\frac{1}{4}$ miles. We had this curious condition, that at some intermediate point the energy of the human voice was found side by side in two different forms—sonorous vibrations in the air, and electric waves in the ether.

There is now no difficulty in communicating with outlying islands if the conditions are favourable. The Northern Commissioners of Lights are anxious to establish electrical communication with the Muckle Flugga Lighthouse, at the extreme north of the Shetland Islands, but the place is so inaccessible that, though the conditions are favourable and signalling without wires is possible and simple, it would be more prudent to adopt the more expensive plan of a submerged cable. I would rather inaugurate the system nearer home, where it could be watched, nursed, and improved. Anyhow, it is something to be able to report that we have now acquired a practical system of signalling across space without the necessity of using wires.

Although this short paper is confined to a description of a simple practical system of communicating across terrestrial space, one cannot help speculating as to what may occur through planetary space. Strange, mysterious sounds are heard on all long telephone lines when the earth is used as a return, especially in the calm stillness of night. Earth currents are found in telegraph circuits, and the Aurora Borealis lights up our northern sky when the sun's photosphere is disturbed by spots. The sun's surface must, at such times, be violently disturbed by electrical storms, and if oscillations are set up and radiated through space, in sympathy with those required to affect telephones, it is not a wild dream to say that we may hear on this earth a thunderstorm in the sun.

If any of the planets be populated with beings like ourselves, having the gift of language and the knowledge to adapt the great

forces of Nature to their wants, then if they could oscillate immense stores of electrical energy to and fro in telegraphic order, it would be possible for us to hold commune by telephone with the people of Mars.

DISCUSSION.

Mr. PREECE, in answer to a question, stated that the experiments described were performed during the severe weather of last week, and that the wind had no effect upon the results.

Mr. W. GRANVILLE said he was not yet converted to the belief that the effects described were produced by induction, or radiation through space, and not by conduction or leakage; but there was one test which would decide the question. An induced current was only capable of producing a temporary action, whereas a current set up by conduction remained permanent as long as the primary current acted. When, in 1842, Professor Morse bridged a river in America by a somewhat crude method, resembling that shown on the diagram, the apparatus then used was only capable of responding to currents of a certain duration, certainly not to those of such small duration as would be produced by induction. Somewhat later Mr. Preece succeeded in bridging the Solent by a similar method, and he took it the instruments then in vogue were such as would only respond practically to currents of somewhat long duration; and there, again, there was simply the effect of conduction. Some years ago, in conjunction with the late Mr. Willoughby Smith, he had the satisfaction of carrying out a series of experiments at Yarmouth, where they succeeded in communicating from the shore to a small boat about a quarter of a mile off by means of two earth plates carried out to sea, but remaining at a distance of a quarter mile from the boat. Those signals were clearly produced by conduction, for they placed a galvanometer in the circuit, and found that, just as long as the battery current remained on, was it deflected, so that the result could not possibly be produced by induction. There had also been experiments by the Telegraph Construction and Maintenance Company, with a view to communicating with lighthouses; and at Alum Bay they communicated with the Needles through a non-continuous cable, bridging a distance of some 60 yards. In that case, a vibrator and telephone was first tried, but afterwards they substituted for it an ordinary galvanometer; and there they ascertained that the effect was produced by a permanent current, and, therefore, by conduction. With regard to the distance one could signal by means of induction through air, it was found, as the result of a large number of experiments, that if they took two spirals similar to those on the table, the sound fell off very rapidly, as the distance increased, and that with a very strong battery current

it was impossible to bridge a greater distance than about 100 yards. The same result was noticeable in the experiment shown that evening. He therefore must remain unconverted until Mr. Preece was able to inform them of the fact that he had placed a galvanometer in the circuit.

Mr. ALEXANDER SIEMENS said Mr. Preece had the great advantage over most of those present that he had conducted experiments on this most interesting subject, while they had not. He understood him to say that in one of his experiments he used two metallic circuits, so that there could be no doubt as to their being real induction, and not conduction currents which he was dealing with. There was one point to which particular attention should be called, viz., that in one case he had succeeded in calling up the other party. In some of the experiments the difficulty was that you had, by means of a boat, or in some other way, to fix the time at which the experiment was going to be made, in order that the man at the other side might be on the watch, but, in communicating with a lighthouse, it was very important to be able to call to your correspondent when you wanted him. If it was necessary, first, to send an ordinary telegram to say you were going to send a message, you might as well send it all at once. No doubt this method of signalling would be much further developed in the able hands in which it was, and a good deal might be expected from it in future.

Major-General FESTING, F.R.S., said he did not quite gather whether the result of the experiments in the Bristol Channel was to show that the two wires would respond to each other if they were both in the water. He understood that they would, if they were both in the air, or both in the water, but that if one were in the air and the other in the water, they would not.

Lieut.-Col. CUNNINGHAM, R.E., said Mr. Preece seemed to lay great stress on the fact that this inductive effect took place through the ether, and that it would probably take place equally in a vacuum. All the experiments were made across water, but he did not catch whether the wires were on both sides up in the air, or on one side in the air, and on the other in the water. He would also ask if there was any advantage in the long wires being parallel to each other, and further, what was the function of the cable paid out by the steam-launch.

Mr. CHARLES BRIGHT said it was a question at a recent meeting of the Society whether submarine cables or land lines were preferable, and the majority of speakers seemed in favour of land lines. He did not agree in that, but these experiments of Mr. Preece's seemed to point to another method of

getting out of the difficulty in cases where a submarine cable was not sufficiently durable, as for instance for communication between lightships and the shore, owing to the continual chafing of the cable on the bottom and against the moorings. In conclusion, he would ask those studying this subject in future to change the title, and he did so in the interest of shareholders and cable contractors, who might think their occupation was gone. It was not really telegraphing without wires, because it appeared that considerable lengths of wire were necessary.

Mr. FREECE, in reply, said he was sorry Mr. Granville should have suggested that he was such a poor electrician as not to have tried the experiment he suggested. One of the first experiments he ever took part in was in the year 1853, when he assisted Mr. Lindsay in endeavouring to communicate across rivers by means of conduction currents. They made a tank to represent a river, and produced very capital results. He had often experimented in that direction, and, as Mr. Granville said, they succeeded in communicating across the Solent, through a broken cable from Hurst Castle, by means of those currents. He did not suppose anybody—unless it were Mr. Granville himself, or Mr. W. Smith—had devoted more attention to conduction currents through water or earth than he had. But there was as much difference between communicating by current through the air and by means of radiation as there was between having a room illuminated by electricity and taking hold of a red-hot poker. All his experiments had been verified by some such system as that adopted on Loch Ness, or by the use of metallic circuits, as was done in London, and also on the Severn and Conway lines. It was quite impossible to conceive that when you had two coils in the air, which were kept wide apart, that there could be any earth action of any sort. Mr. Granville drew attention to the fact that with the two coils he had shown, the sound diminished very rapidly as they were separated. That was so with coils, but if, instead of coils, the wires had been stretched out in straight lines, the distance through which you could communicate increased with the length of the wire; so that if Mr. Granville could communicate with coils 100 yards apart, the probability was that if the same wire had been stretched out straight the distance would have increased to a mile or more. Mr. Siemens had called attention to an important point. The one great difficulty in the earlier experiments was that there was no means of calling attention, but at Loch Ness the sound was so loud at $1\frac{1}{4}$ mile distance that it amounted to a call. The loudness was simply dependent on the materials and means used. With regard to the effects in air and in water on the South Wales coast, and also in the Conway estuary, the sounds were all reproduced in water as well as in air. When the conditions were the same, the effect would be the same. At Lavernock Point, the wires were on 20 feet

poles on the top of a cliff about 70 feet above high-water mark; in this case the electric waves did not pass through the water, they struck the water at a very low angle, which was probably for those waves the angle of total reflection, and the absence of any effect when the cable was sunk, was to him a proof that the waves did not penetrate the water. Had the primary wires been under water there would have been an effect on the submerged cable. He had not experimented in a vacuum, but always either in air or water. How far the air or water took any part in the transmission he could not say, but he had no doubt that the effects would all be traced to the same agency as operated in the case of light and heat, viz., the oscillations of the ether. It was essential to the effect that the wires should be parallel. If the wire on the Flat Holm were perpendicular to the one on Lavernock point he did not think any effect would be produced. The whole theory had been worked out; it was rather complicated and difficult, but he hoped before long to be in a position to write another paper on it. The object of the cable from the launch was first of all to see how far the effects of the earth currents extended, and where the effect of radiation alone appeared. They found that close in shore it made no difference whether the wire was on the surface or submerged, but when they got to a certain distance the difference between the effect of flotation and submersion became evident, and at length submersion caused the effect to disappear entirely. They experimented in that way inland as well as at sea, and inland they were able to plot out the earth currents; they had been plotted, not only there, but for Liverpool, London, and several other places. The object of having the cable suspended was to endeavour to differentiate between the radiations which were evident on the surface, and the earth currents which must have been evident on the surface as well as at the bottom of water. He must admit that the title of the paper was somewhat misleading, but he hoped he had made amends in the concluding particulars in which he had referred to hearing a thunderstorm in the sun, and that he had established some claim to the 300,000 francs which were now lying somewhere in Paris, having been offered as a premium to the man who first showed how to communicate with the inhabitants of Mars.

The CHAIRMAN, in proposing a hearty vote of thanks to Mr. Preece, said the paper had been to him quite a revelation as to matters of which he had hardly ventured to dream as possible. He thought the objection to the title of the paper was rather hypercritical, because ordinary people always understood telegraphing by wire as meaning through the wires going from one station to the other, and these parallel wires not connected would rather be looked upon as the sending and receiving instruments. He hoped, therefore, that the same name would be adhered to in any further de-

velopment of the subject. He was interested in Mr. Granville's observations, but he, at once, thought of the answer which Mr. Siemens gave as being probably the correct one, and that where there were two complete insulated metallic circuits, the effects could not be due to leakage. He could not help thinking, also, having regard to what was known about induced currents, that the fact that no appreciable current was apparent in the receiving wire when it was perpendicular to the sending wire, would seem to indicate that the effect was produced by radiation or induction. He hoped on some future occasion they would have the privilege of hearing from Mr. Preece of the further development of this subject; one branch of it at least deserved further investigation, and that was the suggestion that the electric waves were reflected from the surface of the water. It was obvious that that would account for the fact that there was no apparent transmission from air to water, or from water to air. While at the same time there was transmission when both wires were either in air or in water. Possibly, also, the theory that the medium of transmission was what was understood as ether, was capable of further investigation.

The vote of thanks was carried unanimously, and the meeting adjourned.

Correspondence.

MODERN DEVELOPMENT OF ILLUSTRATED JOURNALISM.

MR. JOHN LEIGHTON, F.S.A., writes:—Mr. Townsend seems to have ignored the early stages of process, where the artist became his own engraver, and laid his own lines before photography and chemistry engraved them for him. I well remember that it was early in the forties that one of the Four-drainers—a son of the inventor of the paper-making machine—had a method that he called gypsograph, it was a drawing with a point made through a surface of plaster down to a plate, and into which lines a stereotype cast entered, producing a relief block, that when bold was effective. Then there was the *Procedé Comte* by which many handsome works were done in Paris, and one has only to instance *L'Art pour tous* and the very large natural history subjects by Karl Bodmer, of Barbeson, that were first published in "*L'Illustration*" to see how the artist's touch was maintained, as in an etching. Then, again, there was "*La Vie Moderne*," an imitation of "*The Graphic*," only it was all process. A system that I employed in my "*Suggestions in Designs*," consisting of 1,200 designs, done in Paris by the Frères Comte and published about 1878, and printed on a tint, in a belief that it would defy photographic reproduction,

but it did not. Had the photographic process developed at the commencement of this work instead of at the end, £500 would at least have been spared.

The great defect of all methods employed prior to 1875, was as it had been for centuries, and as Sir John Tenniel works to this day, the obligation to draw backwards, as upon wood, but without the advantage of alteration.

Chemistry and perfection in printing, aided by the paper-maker, is working wonders, so that now really fine books may be produced at one-fourth of the cost of thirty years since, when the *Livre de Luxe* was worked wholly by hand.

Notes on Books.

"ACROSS THE ATLANTIC." By R. A. Taylor.
The Roxburghe Press.

Mr. Taylor was one of the party of members of the Society of Arts who joined in the excursion to the Chicago Exhibition last year, and in this book he has given a very full account of that excursion. The party reached New York in August, thence proceeding, *via* Philadelphia and Washington, to Chicago, returning by way of Niagara and the Hudson River. From Mr. Taylor's account, all seems to have gone well, and the party appears to have enjoyed itself thoroughly. The arrangements made by Messrs. Thomas Cook and Son, who organised the excursion on behalf of the Council of the Society of Arts, are referred to as being entirely satisfactory.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

FEBRUARY 28.—"Rainfall Records in the British Isles." By G. J. SYMONS, F.R.S. SIR FREDERICK BRAMWELL, Bart., D.C.L., F.R.S., will preside.

MARCH 7.—"Refrigerating Apparatus." By PROF. CARL LINDE.

MARCH 14.—"The Fountain Air Brush." By CHARLES L. BURDICK.

Papers for which dates have not yet been fixed:—

"Reproduction of Colour by Photography." By CAPTAIN W. DE W. ABNEY, C.B., F.R.S.

"London Coal Gas and its Enrichment." By PROF. VIVIAN LEWES.

"Experiments in Aeronautics." By HIRAM S. MAXIM.

"Automatic Gem and Gold Separator." By WILLIAM S. LOCKHART.

"Application of Electricity to the Disinfection of Sewage." By MONS. HERMITE.

"Design Applied to Carpets." By ALEXANDER MILLAR."

INDIAN SECTION.

The meetings of March 8, April 26, and May 24, will be held at the Society of Arts; the meeting on March 19 will be held at the Imperial Institute.

THURSDAY, MARCH 8, at 4.30 p.m.—"The Indian Currency." By J. BARR ROBERTSON.

MONDAY, MARCH 19, at 8.30 p.m.—"Indian Railway Extension: its Relation to the Trade of India and of the United Kingdom." By JOSEPH WALTON. SIR JAMES KITSON, Bart., M.P., will preside.

THURSDAY, APRIL 26, at 4.30 p.m.—"Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh." By SIR AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieutenant-Governor of the North-West Provinces and Oudh.

THURSDAY, MAY 24, at 4.30.—"Chota Nagpore; its Mineral Wealth and its value to India." By J. F. HEWITT, late Bengal Civil Service. SIR ALEXANDER WILSON, formerly President of the Bengal Chamber of Commerce, will preside.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on Tuesdays, at Eight o'clock:—

MARCH 6.—"Travels on the Zambesi." By MONS. FOA.

APRIL 17.—"Tasmania and the forthcoming Hobart International Exhibition, 1894-95." By J. F. ECHLIN.

MAY 1.—"Paraguay." By A. F. BAILLIE.

MAY 29.—"Education in Victoria." By Prof. C. H. PEARSON, M.A., LL.D.

APPLIED ART SECTION.

Tuesday Evenings, at Eight o'clock:—

FEBRUARY 27.—"Goldsmiths' Work: Past and Present." By Mrs. PHILIP NEWMAN. I. HUNTER DONALDSON will preside.

APRIL 10.—"The Evolution of Decorative Art." By HENRY BALFOUR, M.A. SIR GEORGE BIRDWOOD, M.D., K.C.I.E., C.S.I., will preside.

MAY 8.—"Pewter." By J. STARKIE GARDNER. PROF. W. C. ROBERTS-AUSTEN, C.B., F.R.S., will preside.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

HUGH STANNUS, F.R.I.B.A., "The Decorative Treatment of Traditional Foliage."
Four Lectures.

LECTURE II.—FEB. 26.—The *Stem* and its clothing: Growth line of Main-stem—Of branches—Principles deduced from Nature—The Law of exhaustion—The Sheath-leaf—Technical treatment.

LECTURE III.—MARCH 5.—The *Flower*: Principles deduced from Nature—Position—Attitude—View—Varieties—The *Tendrils*: Diffusion of ornamental detail.

LECTURE IV.—MARCH 12.—*Applications*: The Stalk-leaf—Sheath-leaf—Cup-leaf—Rosette—Korinthian leaf—Moulding enrichment.—*Varieties*: The Canon not closed—Individual treatments—Wealth of suggestion in Nature—Further developments.

CAPTAIN W. DE W. ABNEY, C.B., F.R.S.,
"Photometry." Three Lectures.

April 2, 9, 16.

HENRY CHARLES JENKINS, A.M.Inst.C.E.
"Typewriting Machines." Two Lectures.

April 30; May 7.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 26 ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Hugh Stannus, "The Decorative Treatment of Artificial Foliage." (Lecture II.)

Imperial Institute, South Kensington, 8½ p.m. Dr. J. A. Voelcker, "The Agriculture of India and England Compared."

Scottish Society of Arts, 117, George-street, Edinburgh, 8 p.m. 1. Report by Committee on Mr. Leighton's Papers on "A Supersaturator," and "A Chimney Cowl." 2. Dr. Dawson Turner, (i.) "Experiments on Electrical Resistance"; (ii.) "A Lecture Table Experiment on Magnetism." 3. Mr. E. A. Browning, "An Electric Ice Lamp for Table Decoration." 4. Mr. Robert A. Cliffe, "The most Modern Form of Oil Lighting."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

British Architects, 9, Conduit-street, W., 8 p.m. Papers by Professors T. Roger Smith, J. A. Fleming, G. Carey Foster, and T. Hudson Bear, "The New Engineering and Physical Laboratories at University College, London."

Actuaries, Staples-inn-hall, Holborn, 7 p.m.

Camera Club, Charing-cross-road, W.C. 5½ p.m. Annual Meeting, 8 p.m. Mr. G. J. Symons, "How the Camera can Help the Meteorologist."

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Vivian Lewes, "The Chemistry of Clean-
ing."

TUESDAY, FEB. 27 ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mrs. Philip Newman, "Goldsmiths' Work: Past and Present."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Charles Stewart, "Locomotion and Fixation in Plants and Animals."

Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Prof. Henry Robinson, "Sewage and Sewage Disposal."

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Messrs. J. H. Greathead and Francis Cox, "The Liverpool Overhead Railway." 2.

Mr. Thomas Parker, "The Electrical Equipment of the Liverpool Overhead Railway."

Photographic, 50, Great Russell-street, W.C., 8 p.m. Mr. Alfred W. Dollond, "A Method of Modifying Platinum Prints by after treatment."

WEDNESDAY, FEB. 28 ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. G. J. Symons, "Rain-fall Records in the British Isles."

Royal Society of Literature, 20, Hanover-square, W., 8 p.m.

British Astronomical, University College, W.C., 5 p.m.

THURSDAY, MARCH 1 ... Royal, Burlington-house, W., 4½ p.m. Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr.

George Brebner, "Algological Notes from Cumbræ: on the Origin of the Filamentous Thallus of *Dumontia filiformis*." 2. Mr. D. J. Scourfield, "Entomotraca and the Surface Film of Water."

Chemical, Burlington-house, W., 8 p.m. Mr. C. J. Kingzett, "Aerial Oxidation of Terpenes and Essential Oils."

London Institution, Finsbury-circus, E.C., 6 p.m. Rev. Canon Benham, "Old Traditions and Memories of our own Neighbourhood."

Royal Institution, Albemarle-street, W., 3 p.m. Professor Max Müller, "The Vendanta Philosophy." (Lecture I.)

Imperial Institute, South Kensington, S.W., 4½ p.m. Dr. Douglas Sladen, "Canadian and Australian Poets."

Medical and Chirurgical, 20, Hanover-square, W., 5 p.m. General Meeting.

Camera Club, Charing-cross-road, W.C., 8 p.m. Mr. W. B. Crofts, "Light Waves in a Shadow."

FRIDAY, MARCH 2 ... United Service Inst., Whitehall-yard, W., 3 p.m. Surgeon-Captain A. L. Hofer-Dixon, "The Art of Breathing as applied to Physical Development."

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Dr. J. G. McKendrick, "The Theory of the Cochlea and Inner Ear."

Civil Engineers, 25, Great George-street, S.W., 7½ p.m. (Students' Meeting.) Mr. Herbert W. Umney, "Efficiency and Economy of Elevators."

Geologists' Association, University College, W.C., 8 p.m.

Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Mr. Charles Mason, "Scavenging; Disposal of House Refuse."

Philological, University College, W.C., 8 p.m. Queckett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, MARCH 3 ... Royal Institution, Albemarle-street, W., 3 p.m. Lord Rayleigh, "Light: with special reference to the Optical Discoveries of Newton."

CORRECTION.—Page 254, cols. 1, 2; p. 255, col. 2, line 35: for Gibbs read Gibb.

Journal of the Society of Arts.

No. 2,154. VOL. XLII.

FRIDAY, MARCH 2, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

ALBERT MEDAL.

The Council of the Society attended at Marlborough-house, on Friday, 23rd February, when his Royal Highness the Prince of Wales, President of the Society, presented to Sir John Bennet Lawes, Bart., F.R.S., the Albert medal, and a like medal to Sir J. Henry Gilbert, Ph.D., F.R.S., awarded them in 1893, "for their joint services to scientific agriculture, and notably for the researches which, throughout a period of fifty years, have been carried on by them at the experimental farm, Rothamsted."

The members of the Council present were the Duke of Abercorn, K.G.; Sir Frederick Abel, Bart., K.C.B., F.R.S.; William Anderson, D.C.L., F.R.S.; Sir George Birdwood, K.C.I.E., C.S.I.; George Ledgard Bristow; Michael Carteighe; Sir George Hayter Chubb; Major-General Sir John Donnelly, K.C.B.; Sir Henry Doulton; Professor Clement Le Neve Foster, D.Sc., F.R.S.; Sir Douglas Galton, K.C.B., D.C.L., F.R.S.; Walter H. Harris; Lord Kelvin, P.R.S.; Sir Frederick Leighton, P.R.A.; Sir Westby B. Perceval, K.C.M.G.; General the Right Hon. Sir Henry Ponsonby, G.C.B.; William H. Preece, C.B., F.R.S.; Sir Owen Roberts, D.C.L.; Sir Saul Samuel, K.C.M.G., C.B.; with Sir Henry Trueman Wood, M.A., Secretary of the Society, and Henry B. Wheatley, Assistant-Secretary.

CANTOR LECTURES.

On Monday evening, 26th ult., Mr. HUGH STANNUS, F.R.I.B.A., delivered the second lecture of his course on "The Decorative Treatment of Traditional Foliage."

The lectures will be printed in the *Journal* during the summer recess.

Proceedings of the Society.

FOREIGN & COLONIAL SECTION.

Tuesday, February 20, 1894; Sir ALBERT KAYE ROLLIT, LL.D., M.P., Vice-President of the Society, in the chair.

The paper read was—

THE ARTS AND INDUSTRIES OF BELGIUM, AND THE ANTWERP EXHIBITION, 1894.

By EDWARD SÈVE,
Consul-General for Belgium in the United Kingdom.

Belgium, which is the subject of my paper, is, perhaps, the only country where Englishmen have no enemy! I am still moved by the cry of fifteen hundred of your volunteers, when they visited us in Brussels in 1866: "Hurrah for Belgium! We feel ourselves here at home." As member of the reception committee for the *fêtes* organised at that time, I witnessed many touching incidents and tokens of gratitude expressed by your citizen soldiers, who enjoyed for several weeks the hearty hospitality offered to them by all classes, from our gracious Sovereign down to the most humble citizen of the kingdom. For most of your countrymen, Belgium was a revelation. Since that time, we have followed, with deep interest, the great progress made by your powerful empire in arts, in sciences, and in the vast sphere of political and social economy. But I must not forget that I am not here to praise Great Britain: we are all convinced that she is nobly fulfilling her mission in the history of humanity. Let me rather tell you about that little country of ours, which also worthily performs, under the direction of the most popular of kings, her duties amongst Christian nations.

Sir Charles Malcolm Kennedy, chairman of the Foreign and Colonial Section of the Society of Arts, having suggested to my colleague, Consul-General de Courcy Perry, Commissioner-General of the British Section, that a paper should be read at the Society of Arts on Belgium and the Antwerp Exhibition, I asked and obtained permission from my illustrious chief, the Count de Mérode Westerloo, Prince of Rubempré, the Belgian Foreign Minister, to read such a paper; and I gratefully acknowledge the kindness of the Society of Arts in giving me so good an opportunity for speaking about my country; and of Sir Albert Rollit, President of the British Committee, for doing me the honour of presiding.

I think I may say, without fear of being taxed with exaggeration, that no country, except possibly the United States and Great Britain, has made so much progress during the last sixty years, from an economical point of view, as Belgium. The increase of wealth and prosperity in Belgium is obvious to every visitor. Cities have grown in population and splendour; the area of sterile lands has been restricted; the fields, improved by a more intelligent cultivation, have doubled their produce; science, thanks to the new discoveries which have been applied to industry, while diminishing the manual labour of the workman, has increased his wealth by developing his means of existence; canals, roads, and railways without number, transport the products of the country in all directions; an admirable system of credit, with extended ramifications, stimulates a national spirit of enterprise; wages have constantly been increasing; pauperism has diminished; our manufactures are flourishing; and the people, living under the protection of the revised constitution, which, in some respects, is more liberal than that of any country in Europe, is happy and contented.

"Small nations," said the late Louis Hymans, one of our most distinguished historians, "move naturally in a limited circle; their existence is, consequently, deprived of that poetical splendour which attracts the attention of the world, but produces only intoxication and remorse. Since 1830 we have had no other enemies to fight but ignorance and prejudice. We hope never again to come into conflict with any others, for these keep us sufficiently busy. Europe has been for fifty years the theatre of cruel and bloody wars. The sword has often been obliged to cut the Gordian knots which diplomacy was powerless to untie. The combat between races and parties has often assumed gloomy and sinister aspects. Church and State, throne and altar, faith and rationalism, labour and capital, progress and reaction, principles and prejudices, truth and error, have met by turns in frightful conflicts. In the midst of this chaos, Belgium, guided by its fortunate star, has remained undisturbed, and, heedless of the roar of the tempest, has pursued its peaceful and honourable labours."

Of course, much of the development of our material and intellectual resources is due to this uninterrupted peace of more than sixty-three years, but the principal cause of our prosperity lies in the enjoyment of an almost complete political and commercial liberty.

Formerly commercial enterprise was greatly over-regulated by the State—certain industries were protected, while others were hindered in their development. Towns and cities levied dues on every article passing within their walls, and the Custom-house isolated us from other nations. In order to mitigate the evils produced by this deplorable system, the Government offered premiums, granted subsidies, and took tolls, so as to re-establish an artificial equilibrium among producers. These absurd measures, which were intended to serve the interests of the people, and further their commercial undertakings, proved only obstacles and causes of impoverishment.

In proportion, as we have reacted against these restrictive laws, our national activity has grown and increased, and the real prosperity of our people dates only from the times when they broke the bonds which restrained their initiative, and cut away the leading strings which controlled their steps. With these various reforms is inseparably connected the name of M. Frère Orban, one of the greatest of European statesmen and orators; also those of M. Auguste Beernaert, the Premier, and of M. Léon de Bruyn, Minister of Industry, two statesmen of large economical ideas.

Belgium has, at all times, been a trading nation, but the commercial spirit was especially predominant in Flanders and in the province of Liège. In the 11th century all the caravans which carried textile fabrics, jewels and spices, from the East to England, passed through our territory. The Flemings had a great many merchant ships, and history tells us that a Count of Flanders placed a small fleet at the disposal of William the Conqueror when that warrior left Normandy to conquer England. Everybody knows what an important part the Belgians took in those famous religious expeditions, the Crusades. The vast impulse to commercial activity caused by these wars was the means of establishing a regular traffic between the Belgian provinces and Great Britain, and some of our merchants founded factories in London, which became widely celebrated.

Under the reign of the Dukes of Burgundy, the city of Bruges reached the pinnacle of its prosperity, but at the time of the accession of Charles V., Antwerp took the place of that city in commercial importance, and the immense wealth which had made Bruges the metropolis of the Netherlands was transferred to the banks of the Scheldt. We can scarcely

credit to-day the descriptions which some historians have given of Antwerp in the 15th century. They tell us that it was not a rare occurrence to see more than 2,000 vessels in the Scheldt waiting to unload their rich cargoes, taking in exchange Belgian fabrics. We read that in this city business was daily transacted to the extent of several millions of florins; and that Charles V. during his reign collected in Antwerp £10,000,000 sterling extraordinary taxes. It was an Antwerp merchant, named John Daens, who furnished the Emperor with the necessary money to undertake his expedition against Tunis. This loan can have made but a small impression on the finances of the Belgian merchant, for it is said that at a dinner given by him, in honour of Charles V., he pushed his hospitality and generosity so far as to burn his securities before the eyes of his royal guest. But, alas! the prosperity of Antwerp, like that of Bruges, was destined to be ruined and completely destroyed under the domination of Philip II. of Spain. This powerful prince imagined that he had been invested with a divine mission to exterminate the heretics. That he must have been sincere in this belief is certain, for he persecuted the Protestants who, at that time, were the life and soul of our commerce, with such zeal and cruelty that at about the end of his reign the nation was entirely exhausted and had fallen into a state of complete lethargy. The Dutch, who till then had been our friends and allies, became suddenly our implacable enemies. They separated from us, founded the Batavian Republic, and completed our ruin by taking possession of the mouth of the Scheldt.

Then did Belgium pass under the rule of Austria, and though much was done by Charles VI., Maria Theresa, and Joseph II., to redeem the nation, the enmity of Holland and the jealousy of England, prevented those well-intentioned rulers from carrying their projects into execution.

This deplorable state of things continued until 1792, when Belgium was conquered by the French. On November 25 of that year the armies of the Republic entered Antwerp, and a decree was published proclaiming the liberty of the Scheldt. Shortly afterwards a flotilla of six vessels arrived in our commercial metropolis, and was enthusiastically welcomed by the whole population. By this means the Scheldt was re-opened to commerce after a blockade of 144 years. However, our annexation to France did not last long. In 1814, a meeting of plenipotentiaries sent by Austria,

Spain, France, Great Britain, Portugal, Russia, and Sweden, took place in Vienna, and there it was decided, without our knowledge, that Belgium and Holland should be again united under one crown and called the kingdom of the Netherlands. This union, however, was soon severed, for in 1830, the Belgians won their independence and took as ruler a prince of their own choice, in the person of Leopold of Saxe-Coburg, a man well known by your countrymen, and widower of an English princess, who fulfilled his political duties with such a scrupulous exactness and served the interests of his people with such a loyal and profound devotion, that he will ever be held up to future generations as the type of a constitutional ruler.

The year 1830, the date of our emancipation, is also the starting point of the development of our intellectual and material resources; and in order that you may the better realise the exact position of the Belgium of to-day, it is necessary for me to trouble you with a few statistics.

Belgium is bounded by Holland, France, and Germany; it has a line of frontiers amounting to 1,338 kilometres (between 49° 30' 26", and 51° 30' latitude), and an area of about 11,372 square miles. It is divided into 2,659 municipalities, and has a population of nearly 6,500,000 (according to the general census of 1890—6,069,321), that is to say 485 inhabitants to the square mile. No other country of the globe has such a density of population.

The kingdom is divided into nine provinces:—Antwerp—capital, Antwerp; Brabant—capital of the province (and also for the realm), Brussels; West Flanders—capital, Bruges; East Flanders—capital, Ghent; Hainaut—capital, Mons; Liège—capital, Liège; Limbourg—capital, Hasselt; Luxembourg—capital, Arlon; Namur—capital, Namur.

The independent State of the Congo is placed under the sovereignty of Leopold II., on the basis of a personal union with Belgium. The Government of this immense State (the extent of which is 2,700,000 square kilometres, with a population of some 40,000,000) has its offices in Brussels.

The landed property of Belgium is almost entirely divided up into very small holdings, and this is one of the reasons why the country is so admirably tilled and cultivated. In the neighbourhood of the North Sea lies a narrow tract of marshy land called polders, which has been reclaimed from the ocean, producing grass and grain in abundance.

The most completely and most admirably cultivated zone, justly called the garden of Belgium, is the Pays de Waes (Waesland), situated in East Flanders. Besides cereals, our farmers raise colza (otherwise named rape), flax, beetroot (from which 250,000 tons of sugar are made in Belgium), hops, tobacco, and they generally possess a large stock of cattle. West Flanders is celebrated for its big and powerful horses; the colossal animals which draw the heavy brewers' drays in London, attracting the attention of every stranger here, are of Flemish breed.

On the banks of the River Maas there are a few important vineyards, which produce a cheap and palatable wine. In certain places the manipulation of straw has attained a very high degree of perfection, and few are aware that a great many of the straw hats which are sold here as of Italian origin, have been manufactured out of Belgian material in the provinces of Liège and Limbourg, at Glons and Roclenghe.

As to Belgian horticulture, its fame has spread all over the world, and the names of Linden, Van Houtte, Verschaffelt, and Van Geert are known by every amateur and horticulturist.

If agriculture has been highly developed in Belgium, our manufactures have made even greater progress, and their products are sold in all the markets of the globe.

Among them the manufacture of cloth and wool must be placed first. This industry was in a most flourishing condition in Flanders before the times of the religious persecutions, which drove our best hands to the neighbouring countries of Holland, Germany, and England. Although it suffered greatly from those unfortunate events, it never fell into decay, but its centre of activity was transferred from Flanders to the province of Liège. Thanks to modern improvements, our woollen mills have acquired such an importance, that a few years ago there were no less than 500,000 spindles working in the city of Verviers alone.

The manufacture of cotton goods, located in the city of Ghent, which has been called with good reason the Manchester of Belgium, owes the beginning of its prosperity to a certain Lievin Bausvens, who dared to bring English machinery to Belgium at a time when its importation was prohibited under penalty of death. This industry has experienced many a crisis, and when the principles of free trade began to prevail, our manufacturers, greatly alarmed, thought it was impossible for

them to compete with England. Experience has shown them that their fears were only chimerical. At the present day this industry has 800,000 spindles in motion throughout Belgium, and its products have been universally admired at the International Exhibitions of London, Vienna, and Paris.

Linen cloth is another article for which Flanders always had a great reputation. In olden times the flax was spun by our village girls, whose saliva, it was said, had the peculiar property of giving strength and fineness to the thread. This industry suffered greatly at the time when France prohibited the importation of linen goods and England possessed a practical monopoly of spinning by machinery. Dissatisfaction was almost general then. The farmer demanded that the exportation of raw flax should be prohibited, while the spinner and weaver asked with no less persistence for prohibitory duties on all kinds of foreign linen goods. Misfortunes never come singly, says the proverb, for the corn crop having failed that year, and the potato fields having been ravaged with disease, misery became general among the working classes of Flanders. An exhaustive inquiry was ordered by the Legislature. Considerable sums of money were spent in aid of the suffering population, and a series of wise measures were taken to remedy this deplorable state of things, as for instance, the establishment of workshops for apprentices and the abolition of all duties on foreign machinery. Progress soon got the better of routine, machinery drove away the distaff and the spinning wheel, and Flanders, regenerate, again assumed her old place among the most thriving provinces of Belgium.

I should not forget to mention here, by the way, another industry which is almost indigenous with us and has acquired universal fame—I mean lace-making. It would be superfluous to dwell on this article before this audience, who probably know more about it than myself, suffice it to state that the annual production of laces has been estimated at over £4,000,000 sterling.

In connection with the manufacture of textile fabrics, I must say a word about the production of coal, which has been rightly called the bread of all industries. In 1893 the number of tons mined was 20,000,000, representing a value of £10,000,000 sterling. Our mines number 123, worked by 118,000 miners. Zinc, lead, iron, and marble, are also found in great quantities throughout Belgium. The production of cast and pig-iron is very large. The

blast furnaces produced, in 1893, 753,268 tons, and the iron works 479,008 tons of iron, 260,037 tons of steel ingots, and 208,280 tons of manufactured steel products.

Among the countless iron manufactories of Belgium, there is an establishment at Seraing, near Liège, known by the name of Cockerill, its founder, which deserves a special mention on account of its vast proportions and great importance. This company manufacture steel and iron, steel guns, steamers, war and merchant ships, materials for tramways, locomotives. The works extend over 267 acres. The first locomotive of home make which ran on a Belgian railroad, was built in the machine shops of the Cockerill Company, which has perhaps, no other rival in the world.

The manufacture of firearms for sport and war is a specialty at Liège, and its products are in use among savage as well as civilised nations. The royal cannon foundry, situated also at Liège is well known by military people and has furnished engines of war to all the Governments of Europe.

The Belgian glass works are universally famous, and our workmen are highly rated in all countries on account of their skill.

In the enumeration of our national industries, we must rank the sugar mills, the brandy and gin distilleries, and the breweries. I need scarcely tell you that the Belgians are passionately fond of beer, and prefer it in all circumstances to that combination of hydrogen and oxygen called water. It is to be regretted that most of the Belgian brewers have abandoned the old process of their forefathers and betaken themselves to counterfeiting foreign beers.

This brief sketch of our industrial situation will I think enable you to form some idea of our commercial activity, and I will now refer to our admirable net-work of railroads, by which our trade is greatly facilitated. In speaking of railways, I would remind you that this means of conveyance was totally unknown on the Continent about sixty years ago, and that Belgium was the first country which adopted the new invention from England. The project of building the first railroad from Antwerp to the Rhine is due to M. Charles Rogier, one of our wisest and most illustrious statesmen. In Belgium, as elsewhere, the idea met with considerable opposition. Very few people understood how the iron roads, as they called them, would be constructed. Some imagined that carriages, wagons, and all kinds of vehicles were to be attached to the locomotives and pulled in that way over the high roads. M.

Thiers, the great French statesman, considered the innovation a folly, and many intelligent and learned men pretended that railways would cause the ruin of agriculture and the death of the cattle grazing in the fields owing to their digestion being upset by the passing trains. In spite of all these preposterous controversies and absurd arguments, the project of M. Rogier was adopted by an immense majority in the Belgium Legislature, and exactly a year after the promulgation of the law the first train of cars drawn by a locomotive ran over a railway between Brussels and Malines. The formal inauguration of the road took place on 5th of May, 1835, and as it took the character of a national festival, it created a great sensation all over Europe. Ten years after that date, all the principal cities throughout the country were connected by railroads, and at present we have more than 2,000 miles of track owned by the State, which is about a yard to each inhabitant. One can scarcely credit the numbers of railway passengers in Belgium. M. Van den Peereboom, Minister of Railways, Posts and Telegraphs, tells us in his report for 1892, that the State railways transported during that year 68,515,937 persons, giving a net profit of 46,343,229 francs, while the total receipts from goods and passengers, amounted to nearly £6,000,000 sterling (140,691,300 francs in 1893). Exportation being one of the principal branches of the commerce of Belgium, our rolling-stock can be seen in all the countries of Europe, from the South of France to the remotest part of Hungary. I ought to add that, closely associated with the rise and development of railway enterprise in Belgium, stand the names of two Englishmen, Mr. Watts and Mr. Lewis Cubitt.

It may well be asked what is the cause of the extraordinary activity which reigns in all branches of industry throughout the little kingdom of Belgium. The only answer to this question is that we are living under a most liberal Government and a most popular dynasty.

The commercial policy of many nations consists almost entirely in the establishment of custom and excise duties. Custom duties are levied only for two purposes, namely, to fill the coffers of the Treasury and to protect national labour. Protection has played a great part in the history of all nations, especially in reference to agriculture. It is not long since people considered the cheapness of home-raised corn as a national calamity,

because farmers did not make enough money. To remedy this evil, as they called it, Governments would lay heavy duties on the importation of foreign grain. But grain was not always cheap: crops sometimes failed, and in those cases custom duties on articles of food were suppressed or diminished, so as not to oblige the consumer to pay too dearly for his bread. Exactly the same thing was done for cattle, coal, and a great many other commodities. For the taxation of cereals they invented a system called the sliding scale. Under this system, an average price for a bushel of wheat was fixed by the Government, and whenever grain brought more than the official price, custom duties would be proportionately lowered in order to allow foreign cereals to be imported. When, on the contrary, wheat was sold under the official price, the import duties were correspondingly increased, because bread was sold too cheap. How many years of discussion and controversy have been necessary to bring intelligence and learning to bear upon this question!

Truth prevailed at last, and in 1848 the Belgian Government decreed that commerce in grain should be entirely free. This glorious conquest is due to the indefatigable efforts of a small group of men who had founded an association in favour of commercial liberty, among whom we find the name of Charles de Brouckère and of Corr van den Maeren, a true friend of your immortal Richard Cobden. From my youth upwards, I have always been one of the most ardent and sincere apostles of commercial liberty.

Customs reform took place soon afterwards, and at present the Belgian Government does not levy any import duties to protect our national industries, but only for the purpose of raising a revenue. The importation of raw material is completely free, and the very light tax on foreign fabrics is imposed only because of the excise duty which our home manufacturer has also to pay. The income of the customs is only £1,200,000. In 1893, the net income of customs was with the excise duties on wines and spirits, 68,938,431 francs (*Moniteur Belge*, 30th Jan.), out of a general State revenue of 300,288,670 francs, giving, said M. Beernaert, a surplus of 5,912,759 francs; such a result, so rare among European nations, explains the high value of the Belgian State Bonds.

To further the interests of navigation some postal subsidies are given by the State, but no premiums are now granted to encourage the

building of ships, as was done in past times. Private enterprise has to protect itself, and the Government lends only its moral support. This, it is true, is given willingly and liberally. Large subventions have been granted to Exhibitions, and the Consular Corps has been increased since ten years considerably. We have 27 *consules missi* and 418 *consules electi*, 65 of our honorary consuls (*consules electi*) being of British nationality.

The Belgian Government has opened in Brussels, under the control of the Minister of Foreign Affairs, the first Commercial Museum for the exhibition of specimens of raw material and manufactures of foreign countries. Its object is to facilitate the study by Belgian merchants of the products of other countries to enable them to adapt their commodities to the requirements of foreign nations. Belgian merchandise has heretofore reached foreign markets under the guise of English, French, and German goods, and it is believed that the opening of this museum will have the effect of emancipating Belgium from her dependence on the other great commercial States that surround her, and of opening up new and direct relations with all parts of the world. The enterprise has been started in accordance with the generosity peculiar to the Belgian Government, a magnificent building having been appropriated for its purpose. A portion of this building is devoted to each product, so classified that a visitor can at once see its origin and industrial value, while a "bureau of information" is at his disposal to furnish all other information that may be possessed about each sample. A library is attached to the museum containing every native and foreign work and journal that may be of interest to manufacturers and merchants, special prominence being given to notices inviting tenders for all kinds of material and labour products. The museum, the admission to which is free to all, may be regarded as a great industrial educator, and the thorough way in which it is organised insures its success. The advantages it presents are not only in favour of the country itself, but it also affords to foreign merchants and manufacturers an excellent opportunity of exhibiting their goods without expense, the Belgian consular officers all over the world taking charge of samples sent them, and forwarding them without charge for freight, or other incidental expenses. The display of metallic ores, textile matter, and raw materials

in general, present special advantages to foreigners, and the better the samples they send the greater is their chance of establishing direct business relations.

A great many industrial and commercial schools have been founded by the State for the purpose of forming intelligent merchants and working men. Among these institutions of learning, I ought to mention the "Institut Supérieur de Commerce" of Antwerp, a kind of commercial university, which is directed by Mr. Grandgagnage, one of our most distinguished writers and economists. The teaching at this institution is both theoretical and practical. A commercial and banking office, which is annexed to the school, gives the students the opportunity of applying to practice the theoretical principles which are imparted to them by their professors, and a very complete museum of raw and manufactured articles shows them the material position of the different countries of the globe. After two years of study the pupils have to pass an examination before a jury of seven members appointed by the Minister of the Interior, and, if successful, they are furnished with a diploma of doctor (licencié) in commercial law and sciences.

Belgium has a very large import and export commerce, and on account of its geographical situation an immense transit business. In 1851, our commerce was estimated at 356,558,153 francs; at present including import, export, and transit, it has reached the figure of 5,546,342,830 francs, giving an average, for import, of 1,509,220,191 francs; export, of 1,307,104,575 francs; and transit, of 1,364,479,191 francs. Our marine is only composed of 56 ships, of 70,395 tons. Our fishing smacks are 336, which landed, in 1892, 3,216,541 francs worth of fish; they have crews amounting to 1,833 men, and a tonnage of 10,751 tons. The general imports from Great Britain to Belgium, in 1891 and 1892, were 390,940,000 and 349,334,000 francs respectively, and the general exports from Belgium to Great Britain 464,078,000 and 429,559,000 francs respectively. The imports of British manufactures for our home consumption were 199,478,000 and 182,617,000 francs, and our exports of home products were 265,637,000 and 234,550,000 francs during the same years (1891 and 1892). As Sir Albert Rollit said in his address at the Mansion-house that the bulk of the Anglo-Belgian trade is carried on in British bottoms. Of 7,063 vessels, with a tonnage of 5,782,137 tons, and crews of

149,174 men, entering our ports, 50.6 per cent. were, in 1892, of British nationality.

Antwerp, as you know, is the principal seaport of Belgium, and its magnificent position on the river Scheldt gives it many advantages which other cities do not possess. Its harbour is safe, deep, and accessible to the largest merchant ships, and numerous canals and railroads connect it directly with France, Germany, Holland, and Switzerland. During our annexation to France, Napoleon made Antwerp a military port, and called it a loaded pistol directed to the heart of our country. Notwithstanding his warlike intentions, that famous general did much to increase the commercial importance of the city. He ordered new wharves to be built, magnificent docks to be established, and several other important works to be executed. During the last ten years Antwerp has wonderfully improved, and there is no port in Europe which possesses greater facilities for the loading and unloading of cargoes than Antwerp. Its principal articles of importation are grain, rice, tobacco, coffee, hides, fertilizers, wool, and petroleum, for which it is a leading and regular market.

Antwerp is not only a commercial city, it is also a most important centre of art. The artistic circles of Antwerp and Brussels, the musical societies of the large cities throughout the country, organise every year great musical festivities and concerts, at which are performed the great classical and modern compositions. Besides official and public institutions, others have been formed, more numerous still, and among these more than one has assumed a high artistic character. I refer to our choral and instrumental societies, which number at present 2,000, with a total of nearly 30,000 performers, of which 18,000 are instrumentalists, and 12,000 singers. One can boldly affirm that at the present time there is no commune upon the Belgian soil that has not either a society of fanfares or a harmony or choral society. Nowhere, in the opinion of French, English, and German critics, do there exist any choruses of male voices to be compared with some of our singing societies. The English Press has been unanimous in testifying to the triumph and the superiority of the Royal Society of United Artisans of Brussels, which recently, at one of the International Exhibitions at Earl's-court, met with enthusiastic success.

The Belgian Government makes very liberal provisions for art education by a comprehensive system, at the head of which stands the

Académie Royale des Beaux-Arts, in Antwerp. This important establishment was thoroughly reorganised in 1885, and is now for art education what a university is for education in general.

Immediately subordinate to this institution, there are academies and schools of painting, engraving, and architecture in all the principal cities, as well as schools of artistic and industrial drawing (design), modelling, and architecture in the great communes. Altogether, there are in Belgium 80 academies and drawing schools which receive subsidies from the state, provinces, and communes, not including the primary schools, in which the elements of drawing are taught. Thanks to this comprehensive system, there is no young man possessing artistic talents who cannot find means to develop them. Hence, it is not surprising that in the small country of Belgium there are 1,200 recognised artists, of whom 900 are painters.

Those interested in the literature of Belgian art are referred to the writings of Fétis, E. Leclercq, C. Lemonier, A. Michiels, E. Picard, J. Rousseau, A. Samuel, A. Siret, L. Solvay, and Ch. Tardieu.

I have now to say some words about fine arts. This task is a heavy one, and I need all your indulgence to speak upon such a subject, having neither months nor years at my disposal, but only a few moments that I owe to your kind attention and the hospitality of the Society of Arts.

To speak of the fine arts is to speak of the progress of mankind; of the good, the true, the beautiful; of everything that polishes, purifies, and sweetens the manners of nations. You certainly do not expect of me that I should undertake such a task to-night, but you will perhaps allow me to give you a short notice of the history of a school of art which holds a very important position in the artistic world. The beautiful alone is the origin and end of all arts, and leads us to the knowledge of the real principles of art, which are Excellence, and specially Truth. The tendencies of the contemporary Belgian school are directed towards an ideal of Truth, as it always was in the glorious times of the Netherlands, Flemish, and Dutch schools. It will always be the best means of pleasing, elevating, and educating the people. Nothing seems to me more ideal than truth in a work of art. The imagination of a man may be as extended as you wish, but it will never excel what is created by nature. I do not reject academic beauties,

only I prefer the natural sources of what is good, true, and beautiful. I belong to a race which prefers Molière and Shakespeare to Homer and Virgil, Schiller to Goethe, Washington to Napoleon, Beethoven to Verdi, Rubens to David. I candidly confess that, though admiring both, I prefer Rembrandt to Raphael; they both combine the highest ideal qualities, and are great colourists.

The great characteristic of our school of painting has always been an appreciation of colour; our artists inhale the primitive colours—blue, red, and yellow—more completely than any artists of the American, Dutch, English, French, Italian, German, Spanish, or Scandinavian schools; they see colours as they are, and not as their imagination likes to conceive them; they study nature conscientiously, and are gifted, at the same time, with great power of assimilation. "Colour first!" says the Belgian painter, "composition, tone values, perspective will come after." This is the converse of Kaulbach's views when he expressed the strange opinion that colours ought to be left out in the representation of a great ideal composition, as interfering with the artist's imagination. Such ideas are proper for sculpture and drawing, but not for painting—the art of arts.

Belgium has always cherished the fine arts. At a time when almost the whole of Europe was still in darkness, and the nations were oppressed by a serfdom more fatal to individual energy than absolute slavery, the duchies, counties, cities, and boroughs, which constituted the Netherlands (*Pays Bas*), were enjoying local and general liberties more complete than those which were afforded by the Italian Republics.

In mediæval times, Belgium was, industrially, pre-eminent; her commerce extended over the whole of the then known world, and Bruges was, after Venice, the chief centre of commerce. It was from a just appreciation of its position that the old Flemish town was called the "Venice of the North," and Longfellow, admiring the proofs which yet remain of its former prosperity, has embalmed the dead city in some of his most perfect verses.

Immense wealth had been accumulated by the never-ceasing activity and enterprise of the Flemish people, and it was but natural that such universal prosperity should give rise to a refined taste for arts, and that generous and enlightened patrons should encourage the growth and diffusion of this taste. The extent

of the development in this direction is well indicated by the admirable monuments, both secular and religious, that cover the whole country. The hammered copper and iron ornaments in the old churches and other buildings, the carvings in wood and ivory, the numerous examples of silversmith's work, which have escaped the destruction and decay of centuries, give unmistakable evidence of the highest artistic skill and enterprise.

As for painting in those days, it is impossible to form an exact idea of its quality. The work having been executed either in distemper or colours prepared with white of egg, was not permanent, and therefore we can judge of the painters of the 12th, 13th, and 14th centuries only indirectly by the miniatures and illuminations found in prayer-books, copies of the Gospels, missals, chronicles, poems, and novels which are all that remain to us.

The well-known collection of manuscripts in the Bourgogne Library at Brussels, furnishes abundant evidence, that the Belgian designers competed with the best of those of Hungary, Bohemia, and Western Germany, who, living on the highway from Constantinople, had been earlier than others initiated in the Byzantine methods, and, from whom the Belgian miniaturists and designers, whether monks or civilians, learned valuable lessons.

Up to the close of the 14th century no important change in style had taken place. The productions of the painters presented always the same appearance—flat, stiff, without relief or perspective; but a family of artists was then developing, whose destiny was to revolutionise the art.

Jan Van Eyck, his brother Hubert, and their sister Marguerite, according to the most acceptable records, were born in Maseyck, a small city in the Dutchy of Limburg, between the years 1360 and 1370. To that family belongs the credit of creating and giving life to the first Belgian school of painting. Which of the three was principally instrumental in discovering the use of oils in preparing colours; and what part each took in the production of the paintings now in existence, have remained insoluble problems; but it seems clear that they were the first to free themselves from the yoke of the Greek-Byzantine traditions, to throw aside the time-honoured conventionalities of art, to receive from nature their inspirations, and to take their lessons in execution from the same teacher. In the few examples of their work preserved to us (some

of which may be found in the galleries of Bruges, Antwerp, Berlin, Dresden, Munich, Florence, and Paris), it is easy to discover a very decided tendency towards what is called, in our days, realism or naturalism. This tendency has always been, from the time of the Van Eycks, characteristic of the Belgian school, and it is especially notable in the works of that family, that they are the first to attempt the representation of true landscape. In almost all their pictures will be observed a vista (still incomplete and defective in perspective) of woods, hills, pastures, and water-courses. This characteristic alone displays an immense advance over those pictures with backgrounds of gold against which the figures seem to have been glued.

There is also a great advance in expression, the faces revealing human feelings, and indicating spiritual conditions. All the small heads, so finely finished, are full of character.

But, perhaps, the most remarkable characteristic of these works is the permanence of the colours. The famous picture in the cathedral at Ghent, representing the "Adoration of the Paschal Lamb," looks as bright to-day as if fresh from the easel of the painter. It is impossible to find in it the smallest deterioration.

The Van Eycks were the founders of a school, and their disciples, as well as their pictures, were found in every part of Europe. Three of the painters of this school settled in Italy, preparing the way for that great movement which carried the Italian school through centuries of renown (1450 to 1650). Many of these artists remained in the Belgian provinces, and continued the school of Bruges, rendered so famous by the genius of its founders. Very little but their names remain to us, most of their works having been destroyed or lost during the political and religious troubles of the 16th century. But, fortunately, a sufficient number of the works of Hans Memling, who was a pupil of a direct disciple of the Van Eycks, have been preserved from the general destruction, to give us a fair idea of the high position attained by his school.

Memling's work shows a great advance in treatment and effect. It is principally in his portraits—still existing—that we must look for an expression of that realistic tendency of which he continues the traditions. He may be considered as the precursor of Holbein and Dürer.

The last master of the 16th century who

remains true and faithful to the Flemish school is Quentin Matsys, born in Louvain in 1446. Only a few of his pictures have been preserved, but those still extant show a still further tendency towards naturalism. In them scarcely a vestige of the Gothic and Byzantine influences can be seen. The drawing is more correct, the figures are better represented, and the faces are remarkably expressive. In the posing of his figures, too, his skill is notable. It would be difficult to find more powerful expressions of deep grief than those of the characters in his great picture, "The Interment of Christ," which hangs in the museum at Antwerp. With Matsys, and some others less renowned, closes the first period of the Flemish school.

The Italian school was at this time developing with great rapidity. In 1484, some 120 years after the Van Eyck family, Raphael was born. Italy was on the eve of exercising on Belgian art as powerful an influence as the school of Bruges had before exercised in Rome, Florence, and Venice.

Jean Gossart, commonly called Jan de Mabuse, or Johannes Malborius, one of the greatest painters of that period, was born about 1470. He visited England, and some of his pictures can be seen at Hampton Court, in the private collection of M. Deutsch, and in your magnificent National Gallery. Mabuse died in Antwerp, in 1541.

Realism and colour, so characteristic of Flemish art, represented at that time by the school of Bruges, were soon to give place to the pure idealism and the conventionalities of Italy. Barend Van Orley (1488-1542), Michiel Van Coxie (1498-1592), his pupil, and Franz Floris (1518-1570), the three most celebrated of our painters of the century, were far more Italian than Flemish in their work; and their influence was so powerful upon all their fellows that it seemed as if the national genius and tendencies were to be for ever lost. It was, however, only a long slumber that had stilled our energies, and was preparing us for a glorious revival. In the year 1577 Peter Paul Rubens was born. In the latter half of the 16th century were also born Otto Venius (1558), Van Balen (1560), Adam Van Noort (1567), Zeghers (1570), Snyders (1579), De Trayez (1585), Jordaens (1593), and Van Dyck (1599). To that wonderful constellation of masters belongs the honour of having given to Belgium its glorious 17th century, in which its painters won a reputation second only to that of the great Italians of the century before.

It would be useless here to enter into particulars concerning the lives and works of these great men. They are too well known to all lovers of art; and, after the most earnest study, it remains difficult to decide whether their school, or that of the illustrious Italians Michael Angelo, Leonardo da Vinci, Titian, and Raphael should be ranked as the highest.

Before the birth of Rubens, Bruges had seen the beginning, and almost the completion, of its decadence. The current of busy life ebbed from those Flemish cities which had once resisted the kings of England, waged war against France, and revolted so often against their dukes, counts, and barons. In commercial importance, Antwerp took the place of Bruges, and the immense wealth that had made the latter city the metropolis of the Netherlands was transferred to the banks of the Scheldt. For a long period Antwerp remained a focus in which were concentrated the artistic and literary glories of the 16th and 17th centuries. But the 180 years of Spanish and Austrian oppression sapped the life of the rich Flemish provinces. Their industries, commerce, arts, and literature during this period have left no mark. The country seemed to have fallen into a state of perpetual lethargy—to have sunk under a fatal miasma—and the people, once so full of life and activity, moved, like somnabulists, without feeling, and without intelligence.

The great Flemish school appears in the history of the 17th century like a passing meteor, and left no trace of its lustre for almost 200 years. Through all that long period not a single artistic manifestation worthy of mention appeared. It seems as if the few pictures of those times were painted only to prove that the decadence was complete, the collapse final. Liberty and independence were all that Belgium needed, however, to enable her to win back her old position in the world; hence the revolution of 1830, by restoring to the nation, so long oppressed and almost annihilated, its autonomy inspired the people with a new activity. The resurrection of a country is not the work of a few days. Several years were occupied in what may be called the work of preparation before Flemish art, the Belgian school, was ready to take its ancient rank.

About the end of the 18th century, when France was on the eve of the mightiest political revolution that the world has ever known and all men were instinctively conscious of the impending convulsion, one man, an artist of the highest genius, was endeavouring to

revolutionise the art of painting, and to uproot all its old traditions. Revolting against the fictions, the conventionalities, the mincing of the French painters then in favour, Louis David contended that form was the great essential in art. Accordingly, in his teaching and practice, the drawing was the only thing considered; colour was merely an accessory. His success was immense; for the first time, France could present to the world a school of painting. Before Louis David, France had produced great and illustrious artists. Witness the names of Lebrun, Poussin, Claude Lorrain (*Gelee*), Jouvenet, Greuze, Watteau, and many minor painters, such as Boucher, Pater, and Lancret. But her art had never been generalised. Its different systems and methods had not been considered synthetically; no painter had ever founded a school. But from 1785 until 1840, the school of Louis David set its seal on all the painters and their works. Many young Belgian artists went to Paris to work under the direction of this great master. After the year 1815, being then an exile, David opened a studio in Brussels, and there resumed his teachings.

It may be said, without qualification, that David was the director, the inspiring genius of Belgian painters, till about the year 1835. There is no link in the hybrid productions of this period to connect them with the history, the principles, or the æsthetics of the old Flemish schools.

The most conspicuous of David's Belgian pupils was Navez, for many years Director of the Academy of the Fine Arts and Professor of painting in Brussels. He never exaggerated the teachings of his master, but he had accepted them in all seriousness, and remained faithful to them all his life.

In July, 1830, less than two months before the revolution which separated Belgium from Holland, an exhibition of pictures, the "Salon," was opened in Brussels. The pictures sent to this exhibition by a young Antwerp painter, Gustave Wappers, attracted great attention. From the first it was evident that he was trying to revive the old Belgian school. Ignoring all the traditions of the Italian and French schools, he recognised nature as the only model, and colour as the most certain instrument for representing her truthfully, exactly, and comprehensively. His immense picture, "An Episode of the Revolution of 1830," finished in 1834, marks the division between the school of David and the new Belgian school of which Wappers was incontestably the founder and

the first master spirit. Since the representation of that great scene on the barricades all the efforts of Belgian artists have been influenced by the hope of restoring to the national school its old reputation. It is not necessary to name all the artists of importance who have contributed to the success of this movement—for indeed, since the year 1834, every one has nobly fulfilled his share in the great revival.

The Antwerp International Exhibition of 1894 is under the high patronage of his Majesty the King of the Belgians, with his Royal Highness the Count of Flanders, brother of his Majesty, as Honorary President. It will include all industrial, scientific, and artistic productions, as well as all commercial produce. It will comprise maritime, colonial, and African sections; also an exhibition of military art. Simultaneously with the General Exhibition the Antwerp Royal Society of Fine Arts, will hold a special exhibition of painting, sculpture, engraving and architecture, to which artists of all countries are invited to contribute. It is also intended to hold a series of shows and exhibits of live stock, agricultural products, flowers, fruit, &c.

The Exhibition will be inaugurated on May 5th, 1894, and will remain open for six full months, closing at latest on November 12th, 1894. It will be located in the new quarter of the city, in close vicinity of the Scheldt and the new maritime installations and will be connected with the principal railways. It will cover an area of about 200 acres, including a Palace of Fine Arts; and several halls, covering about 120,000 square yards of ground, and intended for exhibiting industrial and commercial products, machinery, electric appliances, &c. These halls will be built of iron and steel, and will be roofed with zinc.

Among the attractions of the Exhibition may be mentioned a representation of mediæval Antwerp, a Congo settlement, Chinese, Algerian, and Tunisian quarters, the Cairo street, from the Paris and Chicago Exhibitions, an Indian encampment, captain Boyton's water show, and a large captive balloon. A series of *fêtes* and conferences is also being organised by the municipality.

A Board of Directors conduct the business of the Antwerp International Exhibition Company and decide all matters of administration and finance, and an executive committee has charge of the organisation and management of all exhibits in the different departments.

By decrees, dated 11th March, 1893, royal commissions of the Belgian and foreign sec-

tions have been instituted, under the honorary presidency of H.R.H. the Count of Flanders ; also a commissariat general of the Government, and general commission of the Belgian and foreign sections. The Belgian commission is presided over by M. Leon De Bruyn, Minister of Agriculture, Industry and Public Works, while the foreign commission, which has for its object to encourage and facilitate the co-operation of foreign exhibitors, is under the presidency of M. Valère Mabilie. The British Commissioner at Antwerp is Mr. De Courcy Perry, the British Consul-General. In a most public spirited manner, that gentleman, upon his own responsibility, applied for, and has been allotted, a space of 60,000 square feet, in one of the best positions, for the purposes of the British Section.

The Belgian minister in England made, on behalf of his Government, a formal application to the Prime Minister, the Right Hon. W. E. Gladstone, inviting this country's participation in the proposed Exhibition at Antwerp ; and at the meeting of the Royal Commission of Foreign Sections held under the presidency of Mr. Leon de Bruyn, Minister of Agriculture, Industry, and Public Works, the Anglo-Belgian Chamber of Commerce of London was commissioned to undertake the preliminary steps for the organisation of the British Section of the Universal Exhibition of Antwerp.

For this purpose a general committee, with Mr. Henry de Grelle Rogier (Vice-President of the Anglo-Belgian Chamber of Commerce, Vice-Consul for Belgium in London) as its Chairman, was appointed with full powers to organise a British commission. An invitation was addressed to Sir Albert Rollit, and the Chamber of Commerce, London, and a most kind and satisfactory response was received by that body. Steps were then taken by Mr. de Grelle Rogier to obtain the adhesion of the most illustrious men in arts, sciences, and industries to form a British provisional committee. On the 22nd of November a first general meeting, under the presidency of Sir Albert Rollit, took place in the rooms of the Chamber of Commerce of London, and this was followed by a meeting at the Mansion-house, on January 23rd, under the presidency of the Lord Mayor.

In closing this paper, I trust that it may have the effect of stimulating British manufacturers to participate in an Exhibition which cannot fail to be of the greatest possible benefit to those who wish to bring their products to the notice of the markets of the continent of

Europe, and I also hope that many visitors will be persuaded to visit Antwerp during next summer. The facilities for reaching Belgium will be very great, and the magnificent fleet of steamers which the Belgian Government have built for the Ostend route are the fastest and best equipped of all the Channel boats. I will only add that during the Exhibition the Belgian State Railways have arranged to issue tickets, available for 15 days' continuous travelling throughout their system, the fares being 40s., 30s., and 20s., respectively for 1st, 2nd, and 3rd class.

DISCUSSION.

Sir CHARLES KENNEDY, K.C.M.G., said they had listened with much attention to the interesting and complete statement of Belgian industry and art which had been put before them by M. Sève, and he was very gratified to be able to be present that evening inasmuch as he was of Belgian descent. The whole subject was one which deserved their warmest sympathies. The economic system of Belgium was a liberal one, and in placing our goods on that market we should be dealing with a country which regarded England and Englishmen with friendly sentiments. In the interests of the trade of Great Britain it was greatly to be hoped that there would be a full and satisfactory representation of British products at the forthcoming Exhibition at Antwerp. We lived now in an epoch of commercial rivalry, and in this condition of competition it was of the greatest importance that foreign rivals should not get any unnecessary advantage over us. International Exhibitions afforded the best means of bringing the products of different nations into juxtaposition. The present scheme was of a *bona fide* character. It was brought forward under the most satisfactory auspices, and there need be no fear on this ground in taking part in it. Our foreign rivals would put forward their goods, and we should suffer grievous loss if we did not take steps to hold our position at Antwerp. A working committee had been formed in London. Mr. Perry, Her Majesty's Consul-General at Antwerp, in a very patriotic spirit, had taken the management of the British Section there, and they had the advantage that evening of the presence of Mr. Layton, the secretary of the British Committee at Antwerp, who was very desirous of entering into personal communication with intending exhibitors and other persons who might be interested in this undertaking. Antwerp was very near at hand ; there was no difficulty in placing British goods in the Antwerp Exhibition, as it could be done at a very moderate cost. There was a sufficiently creditable show of British goods at the Exhibition in 1885, and the London Committee hoped that it would be improved upon in 1894. The Society of Arts had always taken a leading part in

promoting the national objects which International Exhibitions had in view; and the Society was very glad of this opportunity to bring the whole subject before its members and the public. There was one other subject on which he would like to say a few words; he had himself examined into the system of commercial education in Belgium, and he had also visited and thoroughly gone over the Commercial Museum at Brussels, and would strongly recommend any of the members who might proceed to Antwerp to visit the Exhibition, or who might even be passing through Brussels, not to lose the opportunity of making themselves acquainted with what was done in Belgium for the promotion of commercial education and commercial interests. The Commercial Museum at Brussels was a most excellent institution; and it was the intention of the Committee of Management of the Imperial Institute to follow in its steps. How far that would be done he could not say, but he would strongly recommend the members of the Society to visit the Brussels museum, and the technical schools at Antwerp. The former had some very remarkable features, it contained a most excellent inquiry and information office, and it had a unique feature in a department which was devoted to showing merchants how dealers and importers in foreign countries liked the goods which were sent to them to be packed. The English merchant, too, often looked upon that as a detail to which he need not give any attention; but in the Far East, and in the less civilised countries, the manner in which goods were packed and supplied to importers had a great deal to do with determining the source from which they would obtain goods from abroad. There was no place in which the requirements of these merchants could be so well studied as in the Commercial Museum at Brussels. The United States Government had now taken up this subject, and it thus the more required our attention. He wished, also, to say that Belgium was very much indebted to that museum, and to the course of commercial instruction, which had been adopted in late years' to a great extent, under the auspices of his friend, Baron Lambert, Minister of State.

Mr. P. L. SIMMONDS, as one who had had 40 years' official experience in International Exhibitions, and who had the management of the British Section of the Antwerp Exhibition of 1885, said he might perhaps be allowed to make a few remarks. He had listened with much pleasure to the paper read that night, which spoke so hopefully of Belgian industries, but he feared that the proposed Exhibition would have some difficulty in enlisting British exhibitors; first of all because the time was so short. He thought the Antwerp authorities had been somewhat remiss in not bringing this Exhibition before the English public earlier. He admitted that there had been difficulties, because two exhibitions had been proposed this year, one at Brussels and one at Antwerp; these had now been merged into one, but no doubt

delay had been occasioned in making the selection of the place. The next difficulty he foresaw was that we had many manufacturers competing with us in various industries in Belgium. Another difficulty was that we had not the Government influence which the exhibitors of other countries had. The French, German, and other Governments voted large sums of money to assist their exhibitors, and gave them railway facilities. It had been urged by Sir Albert Rollit, at the Mansion-house meeting, that, as a nation of shopkeepers, we were bound to exhibit everywhere, but he was afraid that our manufacturers were getting somewhat tired of exhibitions. There had been so many (about 100) since the first exhibition, which was a national one, and carried out by Government. They had degenerated now into private financial speculations to a certain extent, and were not national affairs taken up by Governments every ten years, as was proposed by the Prince Consort. Then he would ask where were the funds to come from to carry out the British Section satisfactorily. The Consul-General had been appointed to work it there, but, with his official duties, could he devote the necessary time to carry it out? His predecessor, Mr. Grattan, lent him (Mr. Simmonds) very little aid. There was a great deal of jury work to be done, and much financial work in the arrangement and decoration of the court. Would the Consul-General be able to manage this, and had he the funds at his disposal? Again, who was to carry on the necessary correspondence with labourers, the customs, and the committee, which would have to be in French? It was quite true that we had many lessons to learn from Belgium, and he quite agreed with Sir Charles Kennedy that the trade museums which had been established in Belgium, and in many other countries, should be followed in this country, as was proposed many years ago. Almost every country in Europe had a trade or sample museum, and it was highly desirable that we should have such a thing. He wondered that the London Chamber of Commerce had not taken it up. The Chamber of Commerce had helped the Exhibition a great deal, but he was afraid, from the shortness of time and the want of adequate funds, there would be some difficulty in getting a large number of British manufacturers to exhibit. He hoped that, through the Society of Arts and the various Chambers of Commerce, something might be done to get together a satisfactory number of exhibitors.

Prof. LAYTON said he had jotted down a few notes communicated to him by Mr. de Courcy-Perry, Her Majesty's Consul-General in Belgium, a gentleman who was *sans peur et sans reproche*, and who was determined, so far as he possibly could, to see England take her place in the front rank. He wished to be allowed to say what Mr. de Courcy-Perry would have said if he had not, owing to ill-health, been prevented from being present that evening. Mr. de Courcy-Perry had his

attention directed some years ago to the waning influence of British trade, and when M. Sève told him that he was to have the honour of appearing before the Society of Arts and wished for some information upon the matter, Mr. de Courcy-Perry had jotted down one or two observations which he (Professor Layton) would crave leave to read. In his report issued from Odessa some few years ago to the British Government, he called attention to the fact that the competition against British trade was very serious, and was likely to have some grave effects unless something were done to rouse in the British trader a true perception of his own interests, and the following were the sentiments of Mr. Perry in that respect:—"The consuls resident abroad are unanimous in saying that English trade is falling off on account of the push displayed by our foreign competitors; notably the Germans. The Englishman is too fond of trusting to the deservedly wide reputation his manufactures have attained, and he thinks that orders will be sent to him unsolicited. This would possibly be the case if we were not passing through a severe crisis in the conditions affecting the people of all civilised states. The masses are earning large wages, and are becoming imbued with the taste for luxuries, of the possession of which our grandfathers had never dreamed. But the rich, who were once the sole buyers, used a certain discrimination in their purchases, and having the means to pay for a good article, they looked about them and found what they wanted in the English manufacture. But, to-day, the many, who are buyers, have not the capital wherewith to buy anything expensive, though it may be the cheaper in the long run. What happens? The German sends round his traveller able to speak the language of the country in which he travels. This enterprising fellow shows an article, which to outward appearance has all the finish of the English goods, and its price being much lower, the order is given to the German. The proof of the pudding comes only with the eating. The German produces cheaper because he pays lower wages: but low wages mean bad work, and only too late the purchaser finds, like Franklin, that he has paid too much for his whistle. But this might be remedied if the Englishman were on the spot to show his products. But where is he? At home in Birmingham or elsewhere, resting on his laurels of the past. He must be up and doing: he must send his traveller into every place where the German goes, and if he cannot cut his competitor down in price, he will do so in quality, which always pays because it is the cheapest in the end. The Antwerp Exhibition will give the English manufacturer the opportunity he requires of showing his goods alongside those of his foreign competitors, and it will be his own fault if he neglects it." Mr. de Courcy-Perry took up the Exhibition in the idea that it would give to the British manufacturer a capital opportunity of showing himself and his products side by side with foreign made goods, and with all respect, he thought if the English manufacturer did not

profit by the occasion thus given, it would be his own fault. So much for the remarks made by Mr. Perry, and the motives which led him to undertake the very great responsibility attaching to the organisation of an International Exhibition, or rather to the British Section of an International Exhibition. It was from a true patriotic spirit he came forward, and would continue to the end. He should much like to have spoken that evening on the subject of commercial education in Belgium. He felt an immense degree of pride in listening to the paper when it spoke about commercial education in Belgium. For the last ten years he had held the chair of English at the Institut Supérieur de Commerce, or Commercial University of Belgium, and he, probably, was the only Englishman capable of giving to his compatriots a thorough comprehension of the advantages to be obtained by pursuing such a curriculum as that of the institute in question. He would like to descant on the advantages of the institution, but unfortunately time would not permit. A short time ago he was asked by a student to explain how it was that English trade was falling off, and the question was a difficult one to answer. Perhaps he might have the honour on a future occasion of reading a paper connected with the history and details of that famous University which had found imitators in every part of the world except England. Mr. Simmonds had spoken of the difficulty with regard to the correspondence being in French, but there was no difficulty at all about the matter, as Mr. de Courcy-Perry, though he was a thorough Englishman, was master of the French language, and any letter written in French or English would be attended to. The next difficulty raised by Mr. Simmonds was as to money. It was true they had no money, but Mr. Perry had agreed to take the whole financial responsibility on himself. He took the space, and let it to Englishmen; if there were a deficit it would come out of his pocket. What could be fairer than that? Everyone working with Mr. de Courcy-Perry was doing so without pay. Credit was better than money, and having the support of the committee, of which Sir Albert Rollit was the head, they did not want money. Then it was said there was no time; but a Englishman had never yet been daunted by difficulties. If difficulties came let them be overcome. What was the answer of Henry V. at Agincourt when a crowd of French soldiers were coming down to crush the little band of Englishmen? "If we are beaten there is no disgrace, but if we beat them the more honour to us." That remark applied to those promoting the Exhibition; if they overcame the difficulties the more credit to them, but if they were overcome by them, then they had done their best, and would bow their heads, feeling, at any rate, that they had done their duty.

Sir EYRE M. SHAW said he had been delighted with the information given in the paper. They were all aware of the difficulties pointed out by Mr.

Simmonds, and it was to be hoped that under the guidance of the Chairman they would see their way through them. He believed, at the present moment, there was no space unallotted, and he had been given to understand that they were very likely to receive a subsidy from the Government; but whether they had a subsidy or not, he had no doubt that with the steps that had been taken in England the Exhibition would be brought to a successful conclusion so far as the English department of it was concerned.

The CHAIRMAN regretted that, owing to his Parliamentary duties, he had not had the privilege of hearing the whole of the paper. There could be no question that the broad general education given in Antwerp was simply invaluable. Everyone who knew the history of education in Germany would remember that, when France had her heel upon Prussia, the Minister said they must make up intellectually what they had lost materially, and from this must be dated the ultimate triumph of Germany over France of mind over mind. This ought to be an object-lesson to England, and should enlist our sympathy in the direction of education, as every man was jealous of the intellectual, moral, and material progress of his country. There were many considerations which should enlist English sympathy in favour of the proposed Exhibition. He remembered having a conversation with the King of the Belgians, in which the King spoke of their united presence in Africa, saying that he thought, as they rubbed shoulders so close in that country it might lead to political differences; but this had been solved to a great extent by arbitration, and the peaceful character of their dealings with foreign nations, so that this object of anxiety might be passed over. England was indissolubly bound up with Belgium in Africa, in the Congo State. The Belgian state was a country with which England must have many relations, and, consequently, an alliance with them might be of great benefit to ourselves. Again, it must not be forgotten that many English industries were imported from Belgium. England did a great trade with Belgium, in addition to which it did nearly the whole of the carrying trade for that country. They also built their ships, so that the relations between the two countries were very close. Now, what could the Belgians teach us with regard to industries; it was worth while to go to small countries and see what great things were being done. He would mention one thing in agriculture; the Belgians could teach them the great secret of collective agriculture. There was no doubt that with a certain class of land the only economical means of culture was by hand cultivation on a small scale. He was familiar with the agriculture of Denmark. There there was a splendid collective system, and the milk supply of Copenhagen was the most extraordinary piece of organisation that he had

ever seen. The great bulk of the freight of Antwerp was butter, and he thought that Ireland might be a great competitor with Belgium in this matter if the same kind of collective system was adopted. While bills of sale, bankruptcy and receiving orders, had been increasing in England and Scotland, they had been decreasing during the last few years in Ireland, and this, he thought, was a testimony to the industrial legislation set on foot a year or two ago. However much they might differ in politics he thought they should have regard to this fact. Again, in the matter of art they would have the means of improving their knowledge in this respect very greatly, and they might also learn a great deal from the organisation of the docks and port. He remembered on one occasion being wind bound in Flushing and asking why there were no ships in such splendid docks, and he was told that it was owing to the incomparable and utterly unbeatable enterprise of the merchants of Antwerp. This was a great testimony to the organisation of the port and the spirit and enterprise of the merchants. The Commercial Museum was formed to instruct the Belgians how to supply the markets of the world in opposition to their competitors all over the world. In England the only similar thing they had was the Imperial Institute, and he did hope something would be done in this respect to enable English merchants to defend their trade. In England at the present moment there was a want of commercial alertness which required to be stimulated. In this respect he might refer to the fisheries, with which he was somewhat intimately connected. The best example of fishery legislation in Europe was undoubtedly that in force in Belgium. Englishmen were destroying the harvests of their own seas, and notwithstanding the vast increase of catching-power the supply was increasing very little. But Belgium had set an excellent example by limiting the size of the fish to be taken. There was no denying that it was a great tax on manufacturers to exhibit, but still it was to the interest of the commercial public to do so. No firm was so secure in these days of competition that it could simply rest on its laurels. As an American couplet put it, "Early to bed, and early to rise; but it aint no use unless you advertise." Exhibitions were an excellent means of advertising. The first sign of decrepitude in a nation was its unwillingness to exhibit. The London Chamber of Commerce had received from the Government a promise of £200 to enable them to carry on the great work, which sum, though small, would no doubt defray the cost of the clerical labour entailed. He was thankful even for small mercies. In conclusion, he begged to propose a vote of thanks to M. Sève for his interesting address.

The resolution was put and carried.

M. SÈVE in, acknowledging the vote, said that at the present time they had received information that over 1,000 exhibitors from the United States intended

to be present at the Exhibition. He hoped that this number would be exceeded by the English exhibitors. The railway companies had done all that they could to make the Exhibition a success, the London, Chatham, and Dover Railway Company in particular having agreed to carry passengers and goods at a greatly reduced rate.

APPLIED ART SECTION.

Tuesday, February 27, 1894; I. HUNTER DONALDSON in the chair.

The paper read was "Goldsmiths' Work: Past and Present," by Mrs. PHILIP NEWMAN.

The paper and discussion will be printed in next week's *Journal*.

THIRTEENTH ORDINARY MEETING.

Wednesday, Feb. 28, 1894; Sir FREDERICK BRAMWELL, Bart., D.C.L., F.R.S., Deputy-Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Fyfe-Jamieson, James Fleming, M.A., LL.B., South Kensington Hotel, Queen's-gate-terrace, S.W.

Gaynor, Captain H. F., R.E., School of Military Engineering, Chatham.

Middlemore, Thomas, Coleshill-lodge, Sutton-Coldfield, near Birmingham.

Saunders, Edward, St. Ann's, Woking, Surrey.

The following candidates were balloted for and duly elected members of the Society:—

Barnes, Robert, Ormonde-house, 6, Clevedon-place, Brighton.

Harris, Robert, 50, Edith-road, West Kensington, W. Matthews, Edward Eckstein, Ph.D., 18, Cranleigh-villas, Willesden-green, N.W.

Singleton, Charles James, 11, Cleveland-row, St. James's, S.W.

Smith, Willoughby Statham, 13, Courtfield-road, South Kensington, S.W.

The paper read was—

RAINFALL RECORDS IN THE BRITISH ISLES.

By G. J. SYMONS, F.R.S.

Forty years ago, or very nearly so, a well-known engineer, who has recently passed from us—Mr. Bailey Denton—read before this Society a paper, having for its title, "On the Advantages of a Daily Register of the Rainfall."* I can hardly assume that many now

present know much of that paper, or were at the meeting at which it was read; that being the case, it may be well to pass in brief review some of its prominent features, so as to compare the present knowledge of the subject with that existing in the year 1858, as indicated by that paper. Mr. Bailey Denton showed very considerable acquaintance and familiarity with the subject, as was natural with a man whose occupation was largely that of drainage engineer, to whom, of course, the statistics of rainfall were of the very highest importance. He enlisted the co-operation of the former secretary of the old Meteorological Society, and between them they collected returns from about 100 places, and gave the means of those returns, but they did not give any details, nor the dates of any of their observations, simply the arithmetical means; sometimes they stated, sometimes they did not state, upon how many years those averages or means were based. Consequently the means may have been based upon a series of wet years or upon a series of dry years, and there is no indication of the one or the other. In the latter part of his paper Mr. Bailey Denton dealt very strongly with the necessity for ascertaining the best pattern of rain-gauge, and described various patterns which were then in general use, but he said that the difficulty of deciding upon the best pattern was so great that he did not think that any private individual could do it, and there he left the matter. Then came the question of the desirability of an increase in the number of stations, and he worked out the most elaborate scheme which had ever been proposed for the collection of the statistics of rainfall. He proposed that there should be an organisation which should have observers, either one to every five square miles, or one to every ten square miles. He proposed the establishment of a central office, of paid observers, and of paid inspectors, and for one station to every five square miles he estimated the total cost of £26,000, and for one in each ten square miles at half that sum, or £13,000 per annum; and he went on to explain that the importance of the subject in relation to water supply, flood prevention, and agriculture, was so great that he felt sure that such an expenditure would be a wise one.

We have now to consider how far the object, which he then proposed, has been attained, and attained without throwing any such burden as either £13,000 or £26,000 a year upon the country at large. I, personally, was not aware

* *Journal*, vol. vi. p. 114.

of, or present at, Mr. Bailey Denton's address, and did not hear of it until long after I had tried to start something analogous to that which he had proposed. I may, perhaps, just say a few words as to the history of the rainfall organisation, and as to its growth, although it has been purely a gradual matter, and gradual growth is not a thing very easily defined or described. Much about the same date as that at which Mr. Bailey Denton read his paper before the Society of Arts, and in the year following his reading that paper, there was a very considerable drought, and shortly after that Mr. Glaisher, in the *Quarterly Returns of the Registrar of Births, Deaths, and Marriages*, drew attention to this drought, and expressed some doubt as to whether the great deficiency which had been going on for three or four years was likely ever to be made up. That drew my attention to the subject, and in 1860 I collected and printed in the *Builder* a summary of the rainfall for 1859. I have forgotten the exact number of records which I obtained, but it was very small, perhaps something like the 100 which Mr. Bailey Denton had—only his embraced half a century or more, whilst mine were synchronous returns for one year—but the number was approximately identical for the two statements. That table was somewhat favourably received, and it induced me to go on. For the next year, 1860, I had a larger number of stations, and I printed a quarto leaflet, embodying the results at those stations, the total number being, I think, 168 for England and Wales only. I distributed that leaflet to all the observers, and to a good many friends. That was the beginning of the present rainfall organisation. I did not in the first year touch either Scotland or Ireland. In the following year the thing grew, and I obtained returns from those two countries, in addition to England and Wales. In the subsequent year, I laid before the British Association a summary of the work which I had been doing, and that Association, in that year, and for some five or ten subsequent years, gave me small sums of money, or, rather, granted money to a small committee, to be expended chiefly under my own direction in the procuring of fresh rain-gauges, and in the preparation and tabulation of old observations; that is to say, observations prior to the year 1860. The work in connection with the British Association went on, altogether, for 15 years, or thereabouts; but, meanwhile, the work had grown far beyond that which could be carried on by the committee

of the Association, the number of stations had increased, and has gone on increasing until it is now probably rather over than under 3,000, and the idea of Mr. Bailey Denton of stations at intervals of five miles or of ten miles has been realised, or any rate very nearly so. In illustration of which I may point to the map on the wall, which, although not completed up to date, and showing some rather undesirable blanks in the south-west of Ireland, in the south-east of the centre of Ireland, in the neighbourhood of the Caledonian Canal, and in Sutherland, roughly speaking, is covered very fairly and very equably all over, except of course that there is an aggregation of stations where there is an aggregation of population, as in the neighbourhood of the metropolis, in Lancashire and Yorkshire, and similarly near the capitals of Scotland—near Edinburgh and near Glasgow. On that map the ten mile limits alluded to by Mr. Bailey Denton, or at any rate areas of ten miles square, or 100 square miles, are represented by as near as possible one square inch, and, therefore, you will see that there are very few cases in which, even on that map, and that is some years old, there are 100 square miles without a rain-gauge.

It may be well to dispose of the question of the number of stations before opening any fresh subject. I give here a Table showing that the number of perfect records published for 1892 was 2,850.

NUMBER OF PERFECT RAINFALL RECORDS PUBLISHED IN THE VOLUMES OF "BRITISH RAINFALL" FOR THE UNDERMENTIONED YEARS:—

Years.	England.	Wales.	Scotland.	Ireland	Gross total.
1860....	163	5	—	—	168
1861....	334	9	109	20	472
1871....	1,038	88	311	67	1,504
1881....	1,548	131	313	153	2,145
1891....	2,091	168	359	181	2,799
1892....	2,113	177	368	192	2,850

Mr. Bailey Denton did not make it quite clear whether his stations were to be respectively 1 to each 5 or 1 to each 10 square miles, or whether they were to be 1 to each square of 5 miles or of 10 miles—*i.e.*, whether the area was to be 5 square miles or whether the length of the side was to be 5 miles—probably he meant the latter. Adopting it, let us see how nearly his proposal of 1 station to each 5 miles square

—*i.e.*, to each 25 square miles; and 10 miles square—*i.e.*, to each 100 square miles, has been realised.

	Eng- land.	Wales.	Scot- land.	Ireland.	British Isles.
Area in sq. miles	50,387	7,425	29,600	32,513	119,925
If one station to 25 sq. miles..	2,016	297	1,184	1,300	4,797
If one station to 100 sq. miles.	503	74	296	325	1,199
Actual in 1892.	2,113	177	368	192	2,850

From this it will be seen that in England we have more than even the 25 miles area would require, and that Ireland alone has not its fair share of stations. Although I have sent to Ireland, gratuitously, several dozen of rain-gauges, I have had great difficulty in working up the staff even to its present number of 192.

But besides the question of increasing the stations and improving their distribution over the country, much had to be done in the way of experiment. As Mr. Bailey Denton pointed out, there was the question of the best pattern of gauge. Mr. Baily Denton thought that no private individual could do it, and perhaps that, to a certain extent, was true, because I have not done it myself, but I have done it with the co-operation of the many observers to whom the whole success of my work is indebted. In the first place, there is the question of size, whether a gauge should be 1 inch or 2 inches or 8 inches or 2 feet, or even more in diameter. Well, we have tried gauges of nearly all diameters from 1 inch up to 6 feet square, and the practical result is that they do not differ as much as 5 per cent. in any case, and differ to that extent only in extreme cases like the 6 feet gauge, where the indications are disturbed by the excessive condensation of dew; with the exception of that, they all agree within less than 2 per cent. Therefore, it is simply a question which is the most convenient size, and which is the most comfortable for manipulation, and, to a slight extent, which is the least expensive. The consequence is that now, of all the gauges at work something like 80 per cent. are 5 inches in diameter, and the other 20 per cent. are mostly 8 inches in diameter, but about 5 per cent. are of all sizes from 3 inches to 6 feet, so that a 5 inch or an 8 inch is the most usual. It is supposed, but I do not think that there is any evidence to prove it, that in a very windy place, such as on the top of a hill, a 5 inch

is not so good as an 8 inch. That is supposed; I do not assert that it is true. I know that the observations made on the gathering ground of the Bradford waterworks go to contradict it, still, as I have said there are some 8-inch gauges used. Before going any further, I may perhaps refer to the question of the size and pattern of the gauge, partly illustrating them by the examples which I have here. In the first place here are two which differ solely in the material; copper is more durable, but is more expensive than galvanised iron. Copper is nicer to work with, but if anyone wants an extremely cheap and accurate gauge he will have it in this, which is called the galvanised Snowdon gauge. I have it here with packing all complete, as an illustration of how it can go by parcels post all over the country, with a certificate of verification; packing, postage, and everything it can, I know, be delivered at a man's own house for 17s. I may briefly explain the details of the gauge. It will be seen that there is, in the first place, a cylinder some 6 inches high, which is known as the Snowdon cylinder, and the object of which is to collect any moderate fall of snow. If you expose merely a funnel without a protecting cylinder the snow is blown out of the funnel, and you get an inadequate measure of the quantity of the snow. Within the rim, or at any rate, up to 5 or 6 inches of it, the snow can be readily collected. Of course, if the snow continues, the gauge must be emptied, or, at any rate, the snow pressed down. The measurement, when of rain, should be made by pouring the water from the contained bottle into a measuring glass, and reading off its depth. In cases of snow, it, of course, has to be melted, and full instructions are given in our book of rules, which is distributed gratis. In some cases it is not possible to take the gauge every day, as, for instance, on the summit of Scawfell Pike, and places of that kind. Then it is usual to employ what is called a float gauge. A float gauge is a very dangerous instrument unless it is carefully managed. In one case, I believe, a series of float gauges cost one of our Corporations £125,000, inasmuch as those gauges made the apparent rainfall greater than that which there really was; the compensation to the mill owners was fixed in accordance with the wrong gauges, and that compensation had to be bought off for about the sum which I have named. The cause of the mischief may be very briefly explained; the water passes into the inside of the gauge, the float rises, and as it rises (if the

stick be attached to it) the stick is carried above the receiving surface. It then intercepts rain which ought not to go into the gauge, and which would not have gone into the gauge but for interception by the stick. That interception increases the quantity in the gauge, and so led to the trouble which I have mentioned. The cure, an absolute one, a radical one, is that of detaching the stick from the float, and only dropping the stick in at such times as it is required to ascertain what is the amount of rain in the gauge.

For exceptional work, for thunderstorm work, we require a pattern of gauge which can be read at extremely short intervals, and for that there are two patterns; the one that I have here is a double tube gauge, the water passes first into the one tube, causes the white float to rise, and it is perfectly easy to see how the rain is falling minute by minute. When an inch has fallen the first tube is full, and the overflow pipe causes the rain to pass into the second one, and there the record is continued. In another pattern, which I must throw upon the screen, you will see that there is a dial very much like a clock. I need not explain the details further than to say that the rain passes into a cylinder, the float in the cylinder rises, and as it rises it turns the hands round. The long hand completes one revolution for 1 inch of rain, and the short one one revolution for 5 inches, so that the short hand is a counter upon the long hand, just as the hour-hand is a counter on the minute-hand of a clock.

Another form of rain-gauge that we have to consider is that in which we have a record produced whether the observer be present or whether he be not. Many ways have been proposed for doing this, but I do not think it necessary to occupy your attention with more than three or four. In the first place we have the Beckley pattern, the gauge which is adopted by the Meteorological Council, and in which the weight of the water displaces mercury; a cup is floating in a basin of mercury, and it gets gradually more and more immersed, as (owing to the fall of rain) its weight increases. When $\frac{2}{10}$ ths of an inch of rain have fallen the vessel is full up to the level of a syphon, the syphon comes into operation, discharges the water, and the vessel being empty rises to its original level. As the vessel increases in weight it carries a pencil down with it, and, of course, when emptied, the pencil returns to the zero. As the pencil is pressing against the cylinder, which is turned round by a clock, it is perfectly obvious that you get a record of

the intensity, and the time at which the rain fell. Another pattern is Casella's gauge, differing from Beckley's, chiefly in the fact that it avoids the syphon, which is always an objectionable feature in an apparatus, because it is liable to weep over, instead of discharging suddenly, and it avoids the mercury; it substitutes for the mercury a weight, so that we have the counterpoise of a brass weight going at a greater and greater distance from the centre as the weight of the water in the bucket increases. The emptying is very ingeniously done, inasmuch as the bucket by its increase in weight descends, but cannot tip until it gets beyond the end of a small projection. The instant it gets to that point the bucket capsizes, the water is discharged, the bucket goes back to its original place, and the pencil goes back to zero to begin again. Lastly, we have a cheaper pattern, known as Richard's, in which we have the bucket gradually descending by weight, suddenly tipped over in a way slightly different from, but identical in principle with, that in Casella's.

These details as to the patterns of gauges have led us rather away from two other features, which had to be determined before anything like uniformity and excellence of quality could be insured in the observations. Those features are, first of all the material, and secondly the elevation of the gauge above the ground. We tried a number of experiments as to the material, and possibly, if money were no object, and there were no other reasons against it, nothing would be better than ebonite, but there is a question as to how far it would stand the climate, or rather, I should say, the impurities of some of our city atmospheres, and, for all practical purposes, copper seems to be the best thing that we can get. There is, of course, one little difficulty about copper, and that is that it is worth something—it is not worth much, but it is worth something—and the result is that now and then we hear of a copper gauge disappearing. The only way to meet that—and that is the one that we generally adopt—is to paint the outside of it, so that it does not look quite so tempting as a new copper gauge does.

As regards elevation, I should have to detain you a very long time if I told you the whole story. But I may just mention that the first observations as to whether more rain fell on a roof or on the ground were tried, for the first time in the world, more than 100 years ago, and very near this spot, viz., on the top of Westminster Abbey, by the late Dr. Heberden.

He had three gauges, one on the roof of the dwarf tower of Westminster Abbey, one on the roof of a house close by, and another in the garden of the same house. The results for the year 1766 were that in the garden he collected 23 inches, on the roof of the house 18 inches, and on the top of the tower 12 inches. Similar results have been subsequently obtained in various parts of the country, on York Minster and other lofty buildings. It remained, however, for one of my observers to organise a complete series of gauges at slight elevations, varying from the level of the ground, up to 20 feet above it, in order to ascertain whether the decrease with elevation was constant throughout, or whether it was variable, and the result was to show that a very large proportion of the decrease occurs in the first 15 or 20 feet above the ground. Further experiments have been made, but it would take too much time to go into details respecting them, as to the cause of this decrease, but it may be summed up in a very few words, that most of it is due to the velocity of the wind passing over the rain-gauge. The friction of the air against the ground causes it to move with much less velocity there than it does over an exposed position like the top of the centre tower of Westminster Abbey.

I have now a few slides to show with respect to some of the positions of gauges, because a great deal depends upon that. The first one is perhaps more of a curiosity than anything else; it is an illustration of the Eiffel Tower just because that was the greatest height above the ground at which a rain gauge was ever worked. Up above the third gallery to which the public were admitted, there was a light-house, above the light-house there was a complete little meteorological observatory including a self-recording rain-gauge, but the exposure was so great that the amount of rain collected has been excessively small. The next one is a photograph showing where a rain-gauge should *not* be placed, namely, on the top of a railway cutting, a very windy place, and one where the result is considerably less than it would be if the gauge were placed in a normal condition near the level of the ground and on level ground. The next view is that of the wettest station in the British Isles, a place that is known to a great many people by name, at any rate, some miles to the south of Keswick, at the head of Borrowdale, called Seathwaite. The rainfall there on the average of a long series of years, and we have had a gauge there for half a century, is about 140 inches a year,

being nearly six times as great as it is in London. It is wetter still at a point on the shoulder of the hill about half a mile from Seathwaite, and there the fall on an average is about 175 inches. I have only one more view of that kind to show, that of another extremely wet place, Sligachan in Skye, which is almost, if not quite, the wettest place in Scotland. I say almost, but not quite, because during the last two or three years, as most of you are aware, observations have been made on the top of Ben Nevis, which, whether it be due to the extreme care in measuring the snow, whether the snow drifts about and gets measured more than once, or whether there is an enormous fall on the top, there is no doubt that the amounts measured there have been extremely large—larger even than Seathwaite, and larger than Sligachan.

We must now pass to some of the results that we have been obtaining. In the first place, the map now before you is shaded according to the intensity of the rainfall. It is one which is tolerably well known, because it was copied into their sixth report by the Royal Commissioners on "River Pollution," and in that way it obtained a notoriety which it would not have had if it had been merely in my own publication. It shows the rainfall over the British Isles during the period from 1860 to 1865, which period was, although a short one, one which had very nearly the average quantity of rain, and, therefore, although the map is now very old, and, in many respects, it wants amending and replacing by a new edition, still it is a fair approximation to the distribution of the rainfall over this country. It will be seen, of course, that the shading is much darker on the western coasts than it is on the eastern coasts. The shading being proportional to the quantity of rain, that is only another way of saying that it is much wetter on the west than on the east—as everybody knows. But, as regards the details, there are some points which, perhaps, the public are not so fully aware of, for instance, you will see that there is a very wet patch indeed on Dartmoor, and yet on the eastern coast of Devonshire, Torquay, Teignmouth, and all those places, are by no means excessively wet, quite the contrary. So again you have a very wet district in the English lakes, and to the east of it you have a very dry patch. The fact being that the wet has been sucked out, I was going to say, but perhaps condensed would

be a better expression, from the clouds by the highlands, the rain has fallen on those highlands, and, therefore, the clouds have so much less to condense or to deposit on the land lying to the east of them. It will also be noticed that, although Ireland has a reputation for being very wet, there is no part of it, as far as we know, where the quantity of rainfall is nearly equal to that in the English lakes and along the west coast of Scotland; in Ireland, rain is frequent, but not heavy.

The next diagram to which I want to draw your attention represents the relative rainfall of about 160 successive years; that is, not 160 years at any one station; unfortunately, so far, we have not succeeded in getting a station to be continued for even 100 years. There is no station, as far as I know, that has lasted more than 60 or 70 years. The diagram is based upon a series of very long registers which overlapped one another, and then by differentiation we found out what was the relation of the two means one to the other, and so we have got the relative wetness of every one of those 160 consecutive years. It will be seen that in the early part, about 1730, or thereabouts, there is a long period of very considerable deficiency; from 1730 to 1750, and even beyond that, there is a long period of very small recorded rainfalls. Of course, with respect to the observations of that date, we cannot ask any of the observers as to the accuracy of their observations, but I am rather inclined to believe that they would be nearly accurate, and that there may be in store for us in the future a recurrence of some such drought as was then recorded. If there should be, there will be trouble all over the country, because there will be hardly a town that will not be put upon a very short supply of water. It will be noted

that until we come down to very recent times there is no instance of more than five consecutive wet years, but from 1875 to 1883 we have nine consecutive years, every one of which was in excess of the average. It is as unparalleled as the drought to which I have just referred, and as they have happened they may happen again, but we must all sincerely hope that the drought will not. The diagram that I have just shown you does not come down to the present date, and I should explain that that diagram refers to the neighbourhood of Leicester—that is to say, it is based upon a series of records from localities of which that town would be approximately central.

I do not at all desire the mantle of the weather prophet and make no prediction, but just thirty years ago I noticed that for many years two rules seemed to have prevailed—(1) that every year ending with 4 had less than the average rainfall, except when that rule collided with the other rule, which was (2) that every twelfth year back from 1860 had more than the average rain. Thus we get—

Wet.	—	—	—	1836	—	1848	—	1860	—	1872	—
Common to both series.	}	—	1824	—	—	—	—	—	—	—	1884
Dry.		1814	—	1834	—	1844	—	1854	—	1864	—	1874

Thus far the rule has not been broken since 1812. How much longer it will hold good it is not in my power to say.

The next two or three records will be from my own observations. In the first place, I give a diagram showing the relative wetness in London of every year from 1859 to the present time; and there, again, you will see the wetness of the period which I have already mentioned, that period from 1875 onwards.

Average, 35 years (1859 to 1893), 25·82 inches.

YEARLY RAINFALL AT CAMDEN-SQUARE, LONDON, 1859-1893.

	Inches.		Inches.		Inches.		Inches.		Inches.
1850	—	1860	32·24	1870	21·32	1880	30·28	1890	21·23
1851	—	1861	22·27	1871	25·02	1881	27·92	1891	28·15
1852	—	1862	27·59	1872	33·86	1882	27·14	1892	22·60
1853	—	1863	21·59	1873	22·67	1883	24·40	1893	19·80
1854	—	1864	16·93	1874	18·82	1884	20·35	—	—
1855	—	1865	29·48	1875	28·44	1885	26·64	—	—
1856	—	1866	31·60	1876	26·16	1886	27·01	—	—
1857	—	1867	26·29	1877	28·17	1887	19·21	—	—
1858	—	1868	23·40	1878	34·08	1888	27·73	—	—
1859	28·21	1869	25·42	1879	33·82	1889	23·84	—	—
		Average	25·68	Average	27·24	Average	25·45	—	—

The mean monthly fall is given in the next Table, and upon the diagram :—

AVERAGE MONTHLY RAINFALL AT CAMDEN-SQUARE, LONDON, FOR 35 YEARS—1859-1893.

	Inches.		Inches.
January.....	2'06	July	2'41
February	1'65	August	2'39
March	1'68	September	2'41
April.....	1'66	October.....	2'74
May	2'02	November.....	2'37
June	2'34	December.....	2'09

On the average the distribution is very regular, the spring months are comparatively dry, and then the fall increases gradually to October, decreasing again towards the spring. At the upper part of the diagram will be seen a series of black dots. Those show the maximum fall which has occurred in any one month during the whole of the period, and similarly white dots will be seen at the bottom of the diagram representing the minimum fall which has occurred in any one month during the same period. It will therefore be seen that there are several instances in which, in the metropolis, we have had upwards of six inches in one month, and on the other hand that there is hardly a month in which in some year or other the fall has not been less than half-an-inch; the absolute lowest was February, 1892, with only $\frac{1}{100}$ th of an inch of rain.

Lastly, we come to a diagram representing one single rainfall, but it was a very celebrated one, and one which I have always congratulated myself upon having obtained an absolutely perfect record of. I have already shown you the storm-gauge, the one with the clock face, or something like a clock face, and the two hands. On June 23rd, 1878, about one o'clock in the day, thunder occurred and rain began. I scarcely know why, but I at once began recording the indication of the storm-gauge. Having done so, and the fall becoming torrential, I continued it each half-minute until the fall ceased. It is an unusual thing in London for an inch of rain (*i.e.*, 101 tons weight per acre) to fall in 24 hours, but in this case we had a fall of $3\frac{1}{2}$ inches, and it all fell, as you will see from that diagram, in an hour and a half. The maximum rate at which rain can fall is a very important feature indeed, in

designing sewerage and drainage works, and I venture to believe that that record, obtained in that way, has opened the eyes of a good many engineers as to the facts with which they have to deal. (See Table, p. 305).

In conclusion, I should like to show a few views illustrative of two points, first of all the practical application of our knowledge about rainfall to water supply, and secondly, some of the damage which results from floods, with perhaps a word or two as to how they sometimes can be cured. The first view that I intend to show is the site of a bank which will be thrown across that valley, will then shut up that river, and will so form the storage for the city of Birmingham. That is the valley of the Cwm Elan, a few miles west of Rhayader. The next represents a lake already existent, but which has been artificially increased in depth to a considerable extent, so as to supply another of our great centres of population, Manchester. That view represents Thirlmere, and those who know the district will remember that the lake used to narrow in the centre as you see it there, and then widen out to the two ends. One of the results of the local opposition to the Manchester scheme was that they secured a clause whereby the Manchester Corporation were compelled, in some respects, to improve the district, instead of spoiling it. Previous to the passing of the Thirlmere Act there was no public road on the western side of the lake, and it was not convenient for anybody, except pedestrians, to get a good view of Helvellyn. The road on the east side is now submerged, and the Manchester people have had to make a new road in substitution for it, and another new one on the west shore, so that now the public have a complete drive right round the lake. The next view represents part of the gathering ground supplying the town of Cardiff, as taken before the construction of the works. There will be seen a small weir across the stream, constructed for the purpose of gauging the flow, and a sentry-box like erection at the side of it, in which was the apparatus for continuously recording the depth of water passing over the weir, and a short distance to the right is a rain-gauge, used for comparison with the records of the stream-gauge. The last view of this kind is merely to show what very beautiful pieces of work are sometimes buried in hills, where hardly anybody sees them; it represents a portion of the overflow weir constructed by Mr. Mansergh on the Lancaster Waterworks.

DETAILED READINGS OF STORM RAIN-GAUGE JUNE 23, 1878.

Time.				Reading.	Total in 5 min.	Time.				Reading.	Total in 5 min.
1 hour	32 min.	0 sec.	....			2 hours	5 min.	30 sec.	....	
				00						204	
"	37	"	0	01	01	"	6	"	0	208	
"	41	"	0	07	07	"	6	"	30	212	
"	42	"	0	08		"	7	"	0	214	
"	43	"	0	10		"	7	"	30	217	
"	44	"	0	12		"	8	"	0	220	
"	44	"	30	15		"	8	"	30	221	
"	45	"	0	21		"	9	"	0	223	
"	45	"	30	23	26	"	9	"	30	224	28
"	46	"	0	26		"	10	"	0	232	
"	46	"	30	31		"	10	"	30	233	
"	47	"	0	34		"	11	"	0	236	
"	47	"	30	38		"	11	"	30	240	
"	48	"	0	42		"	12	"	0	242	00 for 34 min.
"	48	"	30	46		"	46	"	0	242	
"	49	"	0	49		"	46	"	30	246	
"	49	"	30	56	52	"	47	"	0	250	
"	50	"	0	59		"	47	"	30	252	
"	50	"	30	67		"	48	"	0	254	
"	51	"	0	73		"	48	"	30	257	
"	51	"	30	78		"	49	"	0	260	35
"	52	"	0	86		"	49	"	30	265	
"	52	"	30	87		"	50	"	0	271	
"	53	"	0	88		"	50	"	30	275	
"	53	"	30	89		"	51	"	0	277	
"	54	"	0	91		"	51	"	30	279	
"	54	"	30	96	28	"	52	"	0	286	
"	55	"	0	98		"	52	"	30	288	
"	55	"	30	103		"	53	"	0	292	
"	56	"	0	107		"	53	"	30	295	
"	56	"	30	111		"	54	"	0	298	33
"	57	"	0	114		"	54	"	30	300	
"	57	"	30	118		"	55	"	0	304	
"	58	"	0	121		"	55	"	30	307	
"	58	"	30	126		"	56	"	0	310	
"	59	"	0	129		"	56	"	30	311	
2 hours	0	"	0	146	54	"	57	"	0	314	
"	0	"	30	155		"	57	"	30	315	
"	1	"	0	161		"	58	"	0	316	
"	1	"	30	164		"	58	"	30	319	16
"	2	"	0	168		"	59	"	0	320	
"	2	"	30	171		"	59	"	30	323	
"	3	"	0	175		3 hours	0	"	0	325	
"	3	"	30	178		"	0	"	30	326	
"	4	"	0	185		"	1	"	0	326	
"	4	"	30	195	46	"	1	"	30	327	02
"	5	"	0	202		"	2	"	0	328	

So far we have dealt with the water and rain as a useful servant. Sometimes it is the reverse, and the next few views will tend to show that. The first is that of a gentleman's lawn near Chepstow, buried under about three feet of stones, all brought down from the fields above by a torrential rain. The next is the remains of a Yorkshire cotton mill; a torrential rain or a waterspout, it is difficult to say which, burst on the hills, the water came down to the mill, and you see the result. The next is that of Hereford Railway Station, with the water up to the level of the platform. Then we have Bristol, with the boats going about the streets as they have been doing for 40 or 50 years, perhaps more, at intervals, not every day, certainly; and then we have a little map to show how sometimes these things can be put right. You see there a sketch plan of the town of Bristol, the two rivers, the Avon and the Frome, uniting, and then flowing on past Clifton to the sea, and then you see a line running from the Frome to the Avon considerably below Bristol, marked "Line of proposed relief culvert." Already the floods in Bristol have been materially reduced by straightening and cleaning out the River Frome, in fact, by turning out trespassers; a good many people had encroached upon the river, and obstructed its course. Besides that the Bristol people are now constructing a tunnel along the line of that proposed relief culvert, the result of which will be that when a flood comes along the Frome it will pass down the relief culvert, and go into the Avon below Bristol, hereafter, therefore, the Bristol boys will not have the pleasure of boating in the streets, and the Bristol residents will not need to be amphibious. I have two other slides which I may as well show as illustrating the application of photography to meteorology, which is, perhaps, of some considerable utility. They are two photographs taken of the same place, but not at the same time; they are taken from the west side of Wakefield-bridge; they show the river, the barges, and so forth, and they show the weir. The first slide shows everything in its normal condition, the water going over the weir in a quiet, respectable way. But, in the next one, you will see there is no weir visible at all. That was taken at a time of flood, the year before last, after there had been some four or five inches of rain on the Yorkshire hills, which was passing away, and producing all this inconvenience.

I am conscious of having left very much unsaid, but I must not take up more of your

time, and probably you will agree with me that it is not easy to give in an hour a complete account of the work of more than thirty years. But I hope that I have shown you that without a farthing from Government, and for the last twenty years or thereabouts, solely with the help of the observers themselves, an organisation of considerable importance has been established; the secret of its success has been mutual reliance on the part of the observers and the organisers. I use the word in the plural, because Mr. Sowerby Wallis has helped me so long (more than twenty years) that the work ought to be regarded as a joint one. I used to contemplate with great concern what would become of the rainfall organisation when I was unable to work. To some persons it would be a trouble to find that their personal supervision ceased to be important; to me it is quite the reverse, I rejoice to believe that whenever I have to give up, the work will go on just the same, and perhaps, forty years hence, this venerable room will have a fresh audience, listening to some one who will explain that the progress of rainfall work from 1894 to 1934 has far outdone that from 1858 to 1894.

DISCUSSION.

Mr. R. H. SCOTT, F.R.S., being called upon, said Mr. Symons had given an interesting account of his work, for which they were much indebted to him, but he did not know that there were any points raised on which there could be any difference of opinion, or that he could say much about it except to congratulate the author.

Mr. H. DAVEY said Mr. Symons had put the facts he had collected very clearly, and they were very valuable, especially to engineers.

Mr. R. INWARDS (President of the Royal Meteorological Society), also wished to bear testimony to the admirable way in which the author had marshalled his facts. It showed what one man could do if he gave himself to a subject in thorough earnest, and everyone would agree that that was what Mr. Symons had done. He should like to know if Mr. Symons had prepared anything in the way of a table of corrections for reducing the records of rain gauges at different heights above the ground and for different elevations above the sea; so that observers might know what they must deduct or add to their observations in order to bring them into accord with the ideal rainfall, so to speak.

Mr. EDWARDS asked if Mr. Symons had any record of the historical storm in August, 1846, and how it compared with the one of 1878.

Mr. F. GASTER said he had known Mr. Symons from the commencement of his rainfall work, and had worked for him on different occasions. He should not say anything in the way of criticism, but would say a word or two on some results which had not been mentioned, and on the hopes they held out as to other branches of meteorological work. Many years ago Mr. Symons asked him to discuss the question of the amount of annual rainfall at different stations in the different months, and the careful discussion of a large number of observations led to the conclusion that whereas at the rainy stations in the western and north western parts of the island the maximum fall occurred in the winter, at the dry stations on the eastern side, the maximum fall occurred in the summer. Further investigation as to the cause of this difference led to the conclusion that the maximum fall at the wet stations came with the rain-bearing currents from the Atlantic which accompanied the large depressions and disturbances of winter, whilst the large relative falls on the eastern coast were not produced by large and general rains, but rather by thunderstorms covering only small areas. Secondly, that whereas the winter falls at the western stations continued for long periods and covered a large space, but were increased by the height of the high lands, upon which the warm moisture-bearing currents impinged, the falls at the eastern stations were spasmodic, seldom lasted long, and were often the result of torrential downpours, such as that of 1878. This was important in considering the question of a probable increase or decrease in the rainfall of the United Kingdom and the conditions on which it depended, and whether they would ever be able to find anything like a cycle by which they could estimate more accurately what might be expected in the future. Mr. Symons had only spoken very cautiously as to the prospect of 1894 turning out very dry, like the other years ending in 4, and if they were ever to arrive at any great accuracy in prophecy they must take into consideration the question whether there were not two sets of changes going on, one an increase (during a certain period) of the winter rains from the Atlantic, and another an increase in the summer rains from other causes, and whether these two sets of causes did not sometimes act together so as to swell the total fall for the year, and sometimes counteract each other. He hoped, therefore, that these questions would be further investigated.

Mr. F. O'DRISCOLL, M.P., asked if there was any appreciable difference in the amount of rain caught in the gauges which were turned round so as to face the wind compared with those which were left horizontal on the high posts; also if any hopes could be held out from the past observations of prophecying the future rainfall.

The CHAIRMAN asked if any one present had any information as to the artificial production of rain.

Mr. R. H. SCOTT said the only experiment on at all a large scale in these islands, which he had heard described, was tried in October or November last by the Corporation of the City of Dublin. They went out with all the spare dynamite they could get hold of, and exploded it, but no result followed. It was exploded in various situations, but was not taken up in a balloon. The result of the experiments with dynamite in Texas or Kansas, according to Professor Macfarlane, was to show conclusively that there was no result whatever. If rain was about the country and they happened to make an explosion, then the rain did come down, but as to producing rain by the explosion of dynamite in fair weather, with a dry east wind, it certainly did not occur. Similar experiments had been made in India with negative results; and he had, that day, a letter from Mr. Vaughan, in Fiji, asking his advice about trying such experiments there, and saying that no satisfactory results had as yet been arrived at.

Mr. DAVEY asked if Mr. Symons could give the variations of rainfall on the same watershed at various levels.

Mr. W. MARRIOTT wished to bear testimony to the valuable work Mr. Symons had accomplished. He had not said as much as he might as to the obstacles to getting accurate records in former times. Going about the country and seeing the gauges in various positions and of various sizes, and how badly they had been kept, one could not be surprised that the early records were not so accurate as they now were; thanks to Mr. Symons' careful organisation and his generally accepted rule that the gauge should be one foot above the ground in a fairly exposed situation. The Royal Meteorological Society had a number of stations, and, with one or two exceptions, they conformed to this rule. At the meeting of that society last week, a comparison was made between a gauge placed ten feet above the ground, and one at one foot, and the difference was about 19 per cent., and quite bore out what Mr. Symons had said on that point. There were some very interesting features connected with the investigation. Mr. Gaster had mentioned the winter rains coming mostly from the westward, and the summer rains more inland and on the eastern side, being due mostly to thunderstorms. Such storms were more frequent on low ground, and often followed the track of the lowest ground. During such storms, the amount of rainfall was very uncertain, but it seldom exceeded three inches. There was one case, he believed of five inches having fallen in 24 hours at a place in Norfolk last year, but this was very exceptional. At Seathwaite the greatest fall recorded in twenty-four hours was a little over six inches, and there had only been about ten such instances since the gauge had been kept.

Mr. W. B. TRIPP asked how far the study of the rainfall records, such as Mr. Symons had obtained,

might be assisted by the study of other meteorological conditions, such as the passage of a cyclone, the state of the barometer, the temperatures, and the distribution of such conditions over more or less large areas? In a small country like England they were at some disadvantage, owing to the small area under observation.

The CHAIRMAN said that they were much indebted to Mr. Symons, not only for this paper, but far more for the work he had done for forty years, thus effecting a saving to the country, according to the estimate of the late Mr. Bailey Denton, of from £13,000 to £20,000 a year, but it was really a great deal more, bearing in mind the observers then contemplated, and those now actually working under Mr. Symons. The author had given, very carefully, the diminution in rainfall observed by placing the gauge at certain elevations above the ground, but he had not given any figures showing the increase in the rainfall from going to a greater elevation above the sea, so that he feared, as the paper stood, anyone reading it without further explanation, would conclude that at the summit of Ben Nevis there would be a fall of only about a quarter of an inch a year, which would be a great error. In these days, he believed the observations made under the author's direction might, as a rule, be thoroughly trusted, although he did occasionally get anomalous returns. On one occasion he got a tremendous rainfall returned by a clergyman who kept the gauge, which did not agree with anything else, and there seemed nothing to justify it; Mr. Symons therefore wrote suggesting that there must be some mistake, and received a reply saying that his correspondent was very sorry, but he had sent, by mistake, the amount of the offertory. Of course such mistakes as that no human being could guard against, but as far as care could prevent mistakes, that care was taken. The result was that his "British Rainfall" was the book to which all engineers referred when designing works, either for water supply or sewerage. Where sewage had to be pumped, it was most important to know what had to be provided for as an average, and what as a maximum, so that the engineer might know when he would have to give up pumping and have resort to storm overflows. The matter of water supply—it could not be too frequently urged—was, to a great degree, a question of the quantity of rain that could be depended on, what the late Mr. Hawksley used to describe as the average of three consecutive dry years. Last summer, as in 1887, there were very many important towns which were on the verge of a water famine, than which nothing could be more awful. Fortunately, in London, the much-abused River Thames provided us with an unfailing supply, which was pronounced by a Royal Commission to be very satisfactory, and he believed it was; at all

events, we had no drought; but it was of the greatest necessity that information, such as Mr. Symons had collected for nearly 40 years—for a long time unaided—should be continued. For a time the British Association made a grant, but then gave it up—much against his wish—on the broad ground taken also by the Society of Arts on other matters; that the business of such a society might be to initiate efforts of such a kind, but that to maintain them in perpetuity, if found valuable, other sources must be resorted to. Therefore, the British Association, having more science than money, and having many calls on its funds for the purpose of scientific investigation, felt it could no longer support this work. He was glad, however, to say that the work had gone on, and on an increased scale, notwithstanding the withdrawal of the small grant the British Association used to make. He concluded by moving a hearty vote of thanks to Mr. Symons.

The vote having been carried,

Mr. SYMONS, in reply, having acknowledged the kind way in which his efforts had been spoken of, said at first it was very uphill work, and very costly, and if he had not had a good father in front of him it never could have been done. However, they had worked it up now, and he saw no reason why it should not go on almost for ever; at any rate, long after he was gone. The first question he had noted was as to the correction for the elevation of the gauge above ground, and above sea level, and he was glad that the Chairman had called attention to that point. The corrections for the height above the ground, would be found in the report of the British Association for 1870. They were based on three sets of observations, one only of which, that at Rotherham, he had shown on the screen; the mean of the three being taken. If the gauge were put absolutely on the ground level it would record too much on account of what was called *inplashing*; if it were surrounded by earth or gravel, a good deal of that would get into the gauge, thus proving that rain would splash in from the ground. For that reason he came to the conclusion that the mouth should be one foot from the ground, and preferably over grass. The correction was given for each month because the correction for elevation varied according to the time of year, the reason being that the average velocity of the wind varied, being much stronger in winter than summer. The table therefore gave the correction for each month, and for various heights, from 2 inches up to 20 feet. With respect to the elevation of the ground, as far as he knew that was first reduced to anything like a definite rule by the late Mr. Hawksley in the Varty scheme for supplying Dublin. He did not know the data he used, but his result was that the rainfall increased for every 100 feet of elevation 3 per cent. of the quantity at the lower level. Thus if at a place 200 feet above the sea there were a rainfall of 30 inches, for

another place 100 feet higher 3 per cent. of 30 inches must be added. This was not by any means a universal rule, but it was a first approximation, and furnished a good working hypothesis. It did not apply for example to the two sides of a hill; you could not take the gauge at the bottom on one side and add the 3 per cent. for 100 feet elevation on the other side. He remembered the storm in 1846 very well, though he had not a rain gauge then, being only a boy, but he recollected the rain and hail coming through the skylight of the house in which he lived near Buckingham Palace. Fortunately a record was taken by the late Mr. Dollond, who invented a wonderful apparatus, which he called the "Atmospheric Recorder." It eventually went to Mr. Lowe, of Nottingham, but in 1846 Mr. Dollond had it set up at his residence in Camberwell, and the depth of rain was about the same as that of the storm in 1878, though it occupied rather a longer time. Mr. Gaster had helped him very much in the early part of his work, and the study of the variations in the monthly curve was very interesting. The London curve showed that generally speaking the minimum was in February, March, and April, and the maximum in October, but altogether it was a smooth flowing curve. In the English lake district, however, it was quite otherwise; roughly speaking the maximum months were November, December, and January, and the rainfall was at least double that of the early summer months. He was once giving a lecture on the rainfall, and talking about the Lake district, said there was a good deal of fine weather there in spite of the enormous rainfall; he had spent a month there with only three showers; and that, as a rule, the rainfall in the spring months was extremely small. Unfortunately, there were exceptions, and the vicar of the parish, who was in the chair, took his wife down to the lakes next spring for a holiday, and had a regular drenching. The inclined gauges got considerably more in them than the horizontal ones because, the mouth being turned up, the rain fell perpendicularly into it, producing the same effect as if it were a larger orifice. As regards prophecy, and the study of cyclones and their influence, he had not done anything in that way, his time being fully occupied with the ordinary routine work of recording the observations. If he had three or four additional clerks, he could do much more than he was doing, but he had not John Bull's pocket to go to, and, therefore, he contented himself with trying to get thoroughly good observations. He was very thankful to the observers who had furnished him with materials, and had tried hard, and with considerable success, to get them recorded and printed accurately. He did not believe in printers' errors, and endeavoured to guard against them. These other investigations which had been referred to, might be undertaken by other gentlemen who had leisure to work upon the materials which he furnished.

General Notes.

BARCELONA FINE ARTS EXHIBITION.—Information has been received from the Foreign-office, through the Science and Art Department, respecting a General Exhibition of Fine Arts, to be held at Barcelona, during April, May, and June next. Artists of foreign countries are invited to send their pictures to the Exhibition. The opening is fixed for 23rd April, and the day of closing will be 29th June. Works will be received between 26th March and 5th April. A few forms of application for space have been received.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock :—

MARCH 7. — "Refrigerating Apparatus." By PROF. CARL LINDE.

MARCH 14. — "The Fountain Air Brush." By CHARLES L. BURDICK.

INDIAN SECTION.

The meetings of March 8, April 26, and May 24, will be held at the Society of Arts; the meeting on March 19 will be held at the Imperial Institute.

THURSDAY, MARCH 8, at 4.30 p.m. — "The Indian Currency." By J. BARR ROBERTSON. THE RIGHT HON. HENRY CHAPLIN, M.P., will preside.

MONDAY, MARCH 19, at 8.30 p.m. — "Indian Railway Extension: its Relation to the Trade of India and of the United Kingdom." By JOSEPH WALTON. SIR JAMES KITSON, Bart., M.P., will preside.

THURSDAY, APRIL 26, at 4.30 p.m. — "Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh." By SIR AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieutenant-Governor of the North-West Provinces and Oudh.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on Tuesdays, at Eight o'clock :—

MARCH 6. — "Travels in the Basin of the Zambesi." By Mons. FOA. CAPTAIN LOVETT CAMERON, R.N., C.B., will preside.

APRIL 17. — "Tasmania and the forthcoming Hobart International Exhibition, 1894-95." By J. F. ECHLIN.

MAY 1. — "Paraguay." By A. F. BAILLIE.

MAY 29. — "Education in Victoria." By Prof. C. H. PEARSON, M.A., LL.D.

APPLIED ART SECTION.

Tuesday Evenings, at Eight o'clock :—

APRIL 10.—“The Evolution of Decorative Art.”

By HENRY BALFOUR, M.A. SIR GEORGE BIRDWOOD, M.D., K.C.I.E., C.S.I., will preside.

MAY 8.—“Pewter.” By J. STARKIE GARDNER.

PROF. W. C. ROBERTS-AUSTEN, C.B., F.R.S., will preside.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock :—

HUGH STANNUS, F.R.I.B.A., “The Decorative Treatment of Traditional Foliage.”

Four Lectures.

LECTURE III.—MARCH 5.—The *Flower*: Principles deduced from Nature—Position—Attitude—View—Varieties—The *Tendrils*: Diffusion of ornamental detail.

LECTURE IV.—MARCH 12.—*Applications*: The Stalk-leaf—Sheath-leaf—Cup-leaf—Rosette—Korinthian leaf—Moulding enrichment.—*Varieties*: The Canon not closed—Individual treatments—Wealth of suggestion in Nature—Further developments.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 5.—SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Hugh Stannus, “The Decorative Treatment of Artificial Foliage.” (Lecture III.)

Farmers' Club, Salisbury-square Hotel, Fleet-street, E.C., 4 p.m. Mr. Sapwell, “The Cultivation of the Root Crop.”

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, Town hall, Westminster, S.W., 7½ p.m. Mr. Henry O'Connor, “Pile Driving.”

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Admiral J. H. Selwyn, “The Zymean Metallurgy.” 2. Mr. F. Bale, “The Commercial Production of Chlorine by the Ammonia-Soda Process.” 3. Mr. F. H. Leeds, “Notes on Lithographic Varnish.”

Imperial Institute, South Kensington, 8½ p.m. Mr. W. Senior, “Fish, and Fishing in the Antipodes.”

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. Howard Martin, “The Report of the Local Government and Taxation Committee of the London County Council on the subject of the Rating of Ground Values.”

Medical, 11, Chandos-street, W., 8 p.m. Annual Meeting.

Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. Dr. John Fraser, “The Origin of the Australian Race.”

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. Lewis Morris, “The Present and Future of Poetry in England.”

TUESDAY, MARCH 6.—SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Foreign and Colonial Section.) Mons. Foa, “Travels in the Basin of the Zambesi.”

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Charles Stewart, “Locomotion and Fixation in Plants and Animals.”

Central Chamber of Agriculture (at the House of the Society of Arts), 11 a.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Messrs. J. H. Greathead and Francis Fox, “The Liverpool Overhead Railway.” 2. Mr. Thomas Parker, “The Electrical Equipment of the Liverpool Overhead Railway.”

Pathological, 20, Hanover-square, W., 8½ p.m.

Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Prof. A. Wynter Blythe, “Diseases of Animals in relation to Meat Supply—characteristics of Vegetables, Fish, &c., unfit for Food.”

Biblical Archaeology, 37, Great Russell-street, W.C., 8 p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1.

Dr. J. W. Gregory, “The Factors that appear to have influenced Zoological Distribution in East Africa.” (To be illustrated with lantern-slides.)

2. Mr. W. H. Adams, “The Habits of the Flying Squirrels (*Anomalurus*) of the Gold Coast.” 3.

Mr. W. Bateson, “Two Cases of Colour-variation in Flat-fishes, illustrating principles of Symmetry.”

Inventors' Institute, 27, Chancery-lane, W.C., 8 p.m.

WEDNESDAY, MARCH 7.—SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Professor Carl Linde, “Refrigerating Apparatus.”

Geological, Burlington-house, W., 8 p.m. 1. Mr.

H. M. Bernard, “The Systematic Position of the Trilobites.” 2. Mr. Beeby Thompson, “Landscape Marble.” 3. Rev. P. B. Brodie, “The Discovery of Molluscs in the Upper Keuper at Shrewley, in Warwickshire.”

National Indian Association (Indian Conference-room), Imperial Institute, South Kensington, S.W., 4½ p.m. Mrs. Logan, “Nature and Human Nature in Kashmir.”

Archæological Association, 32, Sackville-street, W., 8 p.m.

Obstetrical, 20, Hanover-square, W., 8 p.m.

Archæological Institution, Oxford-mansion, Oxford-street, W., 4 p.m.

THURSDAY, MARCH 8.—SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Mr. J. Barr Robertson, “The Indian Currency.”

Royal, Burlington-house, W., 8½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Imperial Institute, South Kensington, S.W., 8½ p.m.

Rev. Canon Rupert Morris, “Buddhism in Connection with Ceylon.”

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Max Müller, “The Vendānta Philosophy.”

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Mr. W. M. Mordey, “A Note on Parallel Working through Long Lines.”

Mathematical, 22, Albemarle-street, W., 8 p.m.

Camera Club, Charing-cross-road, W.C., 8 p.m. Mr. F. E. Ives, “Composite Heliography by Three Colour Printing.”

FRIDAY, MARCH 9.—United Service Inst., Whitehall-yard, W., 3 p.m. Major A. M. Murray, “The Necessity of Maintaining the Existing Connection between the personnel of the Field and Garrison Artillery.”

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Mr. W. H. White, “The Making of a Modern Fleet.”

Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Dr. W. H. Hamer, “Infectious Diseases and Methods of Disinfection.”

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical Science Schools, South Kensington, S.W., 5 p.m. Prof. O. Henrici, “Calculating Machines, and especially a New Harmonic Analyser.”

SATURDAY, MARCH 10.—Royal Institution, Albemarle-street, W., 3 p.m. Lord Rayleigh, “Light: with special reference to the Optical Discoveries of Newton.”

Botanic, Inner Circle, Regent's-park, N.W., 3½ p.m.

Journal of the Society of Arts.

No. 2,155. VOL. XLII.

FRIDAY, MARCH 9, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

On Monday evening, 5th inst., Mr. HUGH STANNUS, F.R.I.B.A., delivered the third lecture of his course on "The Decorative Treatment of Traditional Foliage."

The lectures will be printed in the *Journal* during the summer recess.

THE ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1894 early in May next, and they, therefore, invite members of the Society to forward to the Secretary, on or before the 14th of April, the name of such men of high distinction as they may think worthy of this honour. The medal was struck to reward "distinguished merit for promoting Arts, Manufactures, or Commerce," and has been awarded as follows in previous years:—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Michael Faraday, D.C.L., F.R.S., "for discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., "in recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (afterwards Sir) Joseph Whitworth, LL.D., F.R.S., "for the invention and manufacture of instruments of measurement and uniform standards by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to Vicomte Ferdinand de Lesseps, Member of the Institute of France, Hon. G.C.S.I., "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (afterwards Sir) Henry Cole, K.C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. (now Sir) Henry Bessemer, F.R.S., "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For. Memb. R.S., Member of the Institute of France, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to Mr. (afterwards Sir) C. W. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvement in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to Manufactures and the Arts."

In 1875, to Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential service in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., F.R.S., late Astronomer Royal, "for eminent services rendered to Commerce by his researches in nautical astronomy and in magnetism, and by his improvements in the applications of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., Member of the Institute of France, "the distinguished chemist, whose researches have exercised a very

material influence on the advancement of the Industrial Arts."

In 1878, to Sir Wm. G. Armstrong (now Lord Armstrong), C.B., D.C.L., F.R.S., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious labour."

In 1879, to Sir William Thomson (now Lord Kelvin), LL.D., D.C.L., F.R.S., "on account of the signal service rendered to Arts, Manufactures, and Commerce by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

In 1880, to James Prescott Joule, LL.D., D.C.L., F.R.S., "for having established, after most laborious research, the true relation between heat, electricity, and mechanical work, thus affording to the engineer a sure guide in the application of science to industrial pursuits."

In 1881, to August Wilhelm Hofmann, M.D., LL.D., F.R.S., Professor of Chemistry in the University of Berlin, "for eminent services rendered to the Industrial Arts by his investigations in organic chemistry, and for his successful labours in promoting the cultivation of chemical education and research in England."

In 1882, to Louis Pasteur, Member of the Institute of France, For. Memb. R.S., "for his researches in connection with fermentation, the preservation of wines, and the propagation of zymotic diseases in silk worms and domestic animals, whereby the arts of wine-making, silk production, and agriculture have been greatly benefited."

In 1883, to Sir Joseph Dalton Hooker, K.C.S.I., C.B., M.D., D.C.L., LL.D., F.R.S., "for the eminent services which, as a botanist and scientific traveller, and as Director of the National Botanical Department, he has rendered to the Arts, Manufactures, and Commerce by promoting an accurate knowledge of the floras and economic vegetable products of the several colonies and dependencies of the Empire."

In 1884, to Captain James Buchanan Eads, "the distinguished American engineer, whose works have been of such great service in improving the water communications of North America, and have thereby rendered valuable aid to the commerce of the world."

In 1885, to Mr. (now Sir) Henry Doulton, "in recognition of the impulse given by him to the production of artistic pottery in this country."

In 1886, to Samuel Cunliffe Lister (now Lord Masham), "for the services he has rendered to the textile industries, especially by the substitution of mechanical wool combing for hand combing, and by the introduction and development of a new industry—the utilisation of waste silk."

In 1887, to HER MAJESTY THE QUEEN, "in commemoration of the progress of Arts, Manufactures, and Commerce throughout the Empire during the fifty years of her reign."

In 1888, to Professor Hermann Louis Helmholtz, For. Memb. R.S., "in recognition of the value of his researches in various branches of science and of their practical results upon music, painting, and the useful arts."

In 1889, to John Percy, LL.D., F.R.S., "for his achievements in promoting the Arts, Manufactures, and Commerce, through the world-wide influence which his researches and writings have had upon the progress of the science and practice of metallurgy."

In 1890, to William Henry Perkin, F.R.S., "for his discovery of the method of obtaining colouring matter from coal tar, a discovery which led to the establishment of a new and important industry, and to the utilisation of large quantities of a previously worthless material."

In 1891, to Sir Frederick Abel, K.C.B., D.C.L., D.Sc., F.R.S., "in recognition of the manner in which he has promoted several important classes of the Arts and Manufactures, by the application of Chemical Science, and especially by his researches in the manufacture of iron and of steel; and also in acknowledgment of the great services he has rendered to the State in the provision of improved war material, and as Chemist to the War Department."

In 1892, to Thomas Alva Edison, "in recognition of the merits of his numerous and valuable inventions, especially his improvements in telegraphy, in telephony, and in electric lighting, and for his discovery of a means of reproducing vocal sounds by the phonograph."

In 1893, to Sir John Bennet Lawes, Bart., F.R.S., and Sir Henry Gilbert, Ph.D., F.R.S., "for their joint services to scientific agriculture, and notably for the researches which, throughout a period of fifty years, have been carried on by them at the Experimental Farm, Rothamsted."

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday, February 27, 1894; I. HUNTER DONALDSON in the chair.

The paper read was—

GOLDSMITHS' WORK: PAST AND PRESENT.

By MRS. PHILIP NEWMAN.

The subject on which I have been honoured by being asked to speak to-night is a very large one, and one very near to my heart. It em-

braces so many points, its history and theory have been written about, spoken about, divided and sub-divided under so many heads that historically and theoretically there is little that is new to say; but, curiously enough, since the Monk Theophilus wrote his famous treatise in the eleventh century little has been written on the practical side of the question; and, as it is before the Applied Art Section of this great institution I have the pleasure to appear, I shall venture to let my paper take a more technical form than would be desirable for a general audience.

Alloying, melting, working, colouring, and polishing gold, have been my chief studies and occupation for over 25 years; for long years before that I modelled, designed, and drew for goldsmiths' work; and though I should easily be beaten in the use of a blow-pipe, and find it a little difficult to arrange very fine grains with a pallion of solder, yet, I think there is no calculation for alloy or mixing of the precious metals, no pot for melting skittle, plumbago, or other kind, no tool for working, no direction of heat, whether a sharp point of flame, a blunt one, or an all over blast, with which I have not a perfect acquaintance. The different metals necessary to mix with the gold to obtain the softest and richest effects for enamelling, or the different qualities of solder best to use for various kinds of work, wet or dry colour, are all familiar to me; and this every-day experience of mine leads me to hope that I may be able to interest you in the working of the gold and show how it was done in former times, and how it is done now.

There seems to be a general concensus of opinion that gold was the first metal discovered. It is beautiful in colour, was found in rivers, in sand, and on the surface, while other metals had to be dug from the bowels of the earth; it is so attractive in appearance—the most untutored savage would observe its beauty; and it was universally known.

Goldsmiths—that is, men who work in gold—are supposed to have been the first workers in metal, and to have been the pioneers in all the manual arts.

There is a popular idea that gold can only be fashioned by the aid of heat, but, as I had occasion to point out in a lecture I gave last March, before the Society for the Encouragement of the Fine Arts, much of the ancient work was made without the application of heat at all.

In every small treatise, in whatever language it may be written, on our subject, one quota-

tion from an old author is always given, and as there is no better way of expressing the qualities of gold, I will repeat it: "Gold is very ductile, a spreading and oily metal;" and to use an old workshop term, "it is very kind." It can be hammered, drawn as wire, and fashioned without heat; and it is almost the only metal which is ductile enough for this without the aid of steam power.

If we examine many of the oldest specimens, we shall find that they have been worked cold, beaten and twisted into shape by sheer force, which is, literally, an application of heat, but it is not so technically.

There is a tradition that Tubal Cain was the first to make gold-leaf. Anyhow, the art of beating gold is so old that, like the early history of most things, "its origin is lost in obscurity;" but, as every hand-book will tell you, Homer and Pliny both refer to it. Homer also mentions and describes a blast furnace with 20 crucibles; and melting-pots have been found in many places in Egypt.

It was quite possible to have hammered together the little particles of gold found on the surface of the earth and elsewhere, and made them into rough utensils or ornaments without melting the gold at all; but probably as soon as furnaces and melting-pots were known, the gold was melted and run into a rude skillet before the hammering process began.

It would take up too much time to mention the various places where gold was found in bygone times, or to enumerate the usual sources from whence gold is obtained now. Suffice it, for our purpose, to admit that the very first thing a goldsmith needs is pure gold; not that pure gold can be worked, for it cannot. No really chemically-pure gold was ever worked, or ever could be. Many ornaments of refined gold are mentioned by old writers, but in no instance have I found any record of any antique made of pure gold. Purity in this metal is represented by the number 24; standard gold has 22 parts pure to 2 parts of alloy; 18-carat gold has 18 parts pure to 6 parts of alloy. French gold, called 18 carats fine, is not so pure as the 18-carat gold used here; it only assays to 17 $\frac{3}{4}$, or a quarter of a grain worse than would pass Goldsmiths'-hall as 18 carat. The French gold is alloyed with copper, which gives it the reddish tinge. We alloy with both silver and copper, and no point has been more discussed and quarrelled-over than the exact amount of silver and copper necessary to make

the best alloy. It is only 6 parts in 24—not much to wrangle about, you will say.

I will not attempt to give you all the formulæ, or to decide which is best, only, like everybody else, in one particular proportion of silver and gold I believe, and in no other; even when 22 carat gold is to be prepared, the 2 parts of alloy are matters for much comment and dispute. I know two really estimable men who quarrelled bitterly on this question, the one said that of the two parts one should be silver and the other copper, while the other stoutly maintained that the proper proportion was one and a half copper and half silver.

Well, the gold being alloyed to 22, 18, 15, 12, 9 carat, or even a lower quantity of gold, it is put into what is called a pot and melted on a furnace. This furnace can be heated by gas, by charcoal, or by coke; it could be by electricity, but the application is not sufficiently perfected to be used for a goldsmith's furnace yet; however, it will, I hope, be so soon.

When the gold is absolutely fused—and the greater the proportion of gold in the mixture the greater the heat required to fuse it—it is poured into a mould, called a skillet, and allowed to cool; when cold, it is ready for flattening, which is done by rolling it between two heavy steel rollers. It depends on the intended use how thin the metal is rolled. There are gauges for this, like those for wire and sheet metal.

If the gold is wanted for gem rings, it is left thick and cut with shears into slips. I mean for good work. For common work done in Birmingham and Sheffield (and I am sorry to say in London, too), the settings for the stones are stamped out by machinery; and the claws bent over the stones, instead of, as in the best work, the claws being cut to the stone. The goldsmith will, for himself, further flat the gold in small mills if it be necessary for his work. He will also fuse small pieces or cuttings into the shape he desires, on what he would call “a coal,” really a long piece of charcoal hollowed in the centre, for the very old terms are still used in work-rooms (charcoal was called “coal” long before “sea coal” was burnt in the Chapter-house at Westminster, where the first fire was made of what we now call coal, of which we have any record; but this by the way.)

Having arranged his gold in the rough, the workman proceeds to hammer it more nearly into the required shape, if it be for a ring with

stones in it; after he has fused a thick mass for the head he hammers a long straight piece (cold work, you see), then with his pliers he bends it round to get it roughly into shape, then he files the inside to get it smooth enough to make it the desired size to fit the finger, it is then filed and scaupered into shape, carved and clawed. The ring is soldered together at the back, it is polished with sand-paper, with “water air stones,” which look very much like slate pencils, and with hard wood. The little claws are “threaded out,” *i.e.*, polished with whitey brown thread, on which a little rouge has been rubbed. So far, all work goes through these processes, whether it is to be finished bright or coloured; the last thing done is setting the stones.

Now, you will perceive that the gold was alloyed and melted into an ingot; so far, heat was used, but for the flattening no fire is necessary. Tradition—and all tradition has a basis of truth—says the gold the ancients made the ornaments for the dead from was beaten into the thin plates from which the wreaths, &c., were cut between thin layers of leather, and beaten with a very heavy hammer. Gold-beaters now beat their gold between thin leaves of vellum. The thin gold used by the ancients for their funeral ornaments was of the same degree of fineness as that beaten now, which has about one part alloy, either silver or copper, to twenty parts of pure gold. The alloy diminishes the malleability, so the inducement is only small to deteriorate the quality, for gold leaf is sold by size, and not by weight.

Now, the gold is cast into oblong ingots, about $\frac{3}{4}$ of an inch thick and wide, and each weighing about 2 ozs.; this is flattened into a ribbon about $\frac{1}{16}$ th part of an inch thick, then annealed or softened by heat, and cut into pieces about an inch square; 150 of these are put between vellum, each piece of gold in the centre of a square of vellum; another and another added, until a pile of 150 is made. This pile is enclosed in a double parchment case, and beaten with a 16 pound hammer; the elasticity of the packet lightens the labour, as the hammer rebounds with each blow. The beating is repeated, until the inch pieces are spread out to four-inch squares; they are then taken out, cut into four pieces each, placed this time between gold beaters' skin, and hammered as before, but this time with a lighter hammer; they are again quartered, and again hammered, thus producing 2,400 leaves, having an area of nearly 200 times that

of the ribbon, and a thickness of $\frac{1}{200000}$ of an inch.

The soldering of the ancients was something very marvellous. Castellani is of opinion that, so far as gold work was concerned, they were better chemists than we are, and used solvents with which we are unacquainted.

The delicate grain work with which the Etruscan covered large surfaces is not easy to imitate. Here is a little piece roughly done, as an illustration; but there are few men who can do it now.

For a long while after the Etruscan gold work came to light, it was found impossible to copy the colour of the gold, but now we can get it exactly, by putting the proper proportion of common salt, saltpetre, and alum in a flat-bottomed pot with distilled water, and heating to 212° Fahr. This mixture is not pretty to look at, for it boils up a pale, sickly, greenish colour.

The gold work to be coloured should not be of less than 18 carats fine. It is hung from a platina ring with either platina wires or horse-hair; there should be plenty of it, for the greater the amount of gold to be coloured the better the colour of each article. The work, having been properly cleaned, is dipped into the boiling mixture, taken out, dipped into clean boiling water, dipped into the colour pot again, again washed in hot water: about the third dip the rich bloom of colour comes. Much more washing is still necessary before the work is ready to dry in hot boxwood dust, after which it is scratch brushed. This is a scratch-brush: the hole in the centre fits on to the mandril of a foot lathe, the article to be finished is held against the revolving brush in the hands of the workman. Now, nothing is so good to feed the scratch-brush with as *beer*; this drops on the revolving brush from a little hole in a small tub fixed over the lathe, so that the beer drips on the brush as it revolves.

If this scratch-brushing is done by a clever operator, 18 carat gold has the beautiful bloom of the best Etruscan work; this is the very reverse process of gilding, for in gilding pure gold is added to and spread over the surface, while, in colouring, the alloy is eaten from the surface, leaving only pure gold visible. We know that the Japanese derive some of their ideas from the most crystallised of all old time peoples—the Chinese. Shall we ever have a more intimate acquaintance with their inner life, and their old tradition, and find out whether the Japanese “pickles,” as their colouring mixtures are sometimes called, are made from early traditions of the craft—

traditions of the knowledge emanating from the Hindoo Koosh, but lost lore to European nations? As to the processes, by which the result was obtained in the old work, we have little to aid us; but we may safely say that whenever the work was done, in prehistoric times, in Egypt, in Assyria, in the cities of Italy occupied by the Etruscans, in Greece, in Rome, or nearer our own time, in Florence, it was not the working that was so very different from our own, it was the almost intuitive feeling for art that made the gulf between the goldsmiths' work in the past and to-day.

In very early times mechanical aids to repetition were adopted; the Greeks used dies for the little amphoræ they were so fond of hanging round their necklaces; no doubt, also, they made cutters for the pateræ so often seen in Greek and Græco-Etruscan work. I do not suppose they had any better equivalent for a monkey press than a sledge-hammer, but they had that. Yes, the old craftsmen beat, flattened, and annealed their gold; they drew wire, they twisted it, they screwed it, they did *repoussé* work, they engraved the most beautiful intaglii on their gold rings; they knew how to prepare their work for the inlaying of stones, of which enamelling was only an imitation, and in the earliest times they understood Cloisonné and Champlevé enamels. At the present time all these things are done, but we do not often have artists to make the dies, and we depend too much on the dies; it is the curse of cheapness that spoils our work. Now, necklaces, brooches, bracelets, are made by the dozen, all alike. It spoils the work, and it spoils the workers, for instead of a man being able to make all usual trinkets right through himself, it is found cheaper for a foreman to give so many articles, all to be alike, to one man, who takes so many boys under him. These boys are only taught to do one portion of the work, some only learning to make snaps, others only joints, others only tongues and catches. In after years what is to become of these lads? The men who teach them can only make one thing; a brooch-maker can only make brooches, and so on, and of the separate parts of that thing he teaches so many boys to make one part only; not one of them could put them together from anything taught in their factory, and but few lads have the wish or the application to learn more than they are taught. No, it was a better time when the old system of apprenticeship prevailed, and it was to the masters' interest to teach a boy to be a thorough good

workman. When the goldsmiths who have been apprenticed are all dead and gone, where will the craft be then? The boys "taken on" will not be of any use, indeed, many of them now finding it impossible to get their bread with the knowledge they have acquired, go for soldiers, so the little they have learnt is lost.

If technical schools would only supplement proper apprenticeships instead of attempting to be a substitute for them, they would do much good. Reading all about an art for a year, is not so useful as working with others who know and exercise it for a month. Practice is necessary, has always been necessary, and will always be so. There is no art, craft, or trade where constant practice is so necessary as that of a goldsmith. I know of several goldsmiths now whose technical work is quite equal to that of the best periods, but, they have not only served their time, but have lost no opportunity since their apprenticeship expired of learning more about their work. Such goldsmiths are becoming more scarce every year.

In old times, in all ages, and in all places, there were two separate and quite distinct branches of goldsmiths' work. In the one case, the work done for the temples in honour of the cult of the people; in the other, for the houses of their chiefs and kings, and for the adornment of their women; but it seldom happened, until at any rate comparatively recent times, that the secular work was done by the same craftsman as the work for religious purposes.

In the early Christian times there was little sacred art at all; the sect was too poor and despised; but, as Christianity gained noble and rich converts, and the church became a power, it was only natural that their places of worship should become more magnificent than the heathen temples had been; and that much of the gold and silver of the temples should be melted up and remodelled for the service of the Church.

How far back guilds of workers in gold can be traced I am sorry I cannot tell you, but we must suppose that the "Aurifices" of Rome formed a sort of corporation, for they erected a little triumphal arch in honour of Septimius Severus in the "Velabrum;" this arch does not bear any characteristic mark of goldsmiths' or their work.

In Rome I have seen ancient inscriptions bearing these words, "AURIFEX AUG.," "AURIFEX AUGUSTÆ," "AURIFEX TIB: CÆSARIS," "AURIFEX LIVIÆ," &c. The

inscriptions prove that in and after the times of Augustus and Livia, emperors and empresses had goldsmiths in title attached to their service; similar inscriptions to these have been found in Britain I believe.

The Gallic people have long traditions as goldsmiths, for records remain of goldsmiths in Limoges before the invasion of Julius Cæsar. The name of only one Gallo-Roman goldsmith has been preserved; it was Maburnius, he is mentioned in a will of the 5th century. Perpetua, Bishop of Tours, left the silver cross he used to wear and some other trinkets to a brother bishop, because he leaves the gold cross, &c., made by Maburnius to his Church.

There were, and I hope still are, in the Cabinet of Antiquities in the Bibliothèque Nationale, Paris, the hilt of a sword in gold, gold bees, and other objects, found in the tomb of King Childeric at Tournay, all of beaten gold.

One of the apprentices of Abbon, at Limoges, a youth named Eloi, was afterwards one of the patron saints of French goldsmiths. St. Eloi, in his early days, was ordered to make a seat for the king—whether a saddle or a chair has never yet been quite decided—but he worked so diligently, so carefully, and so honestly, that out of the gold entrusted to him he made two seats, without either being in any way defective, and he made the two in the time he was expected to make one; small wonder that he became minister to Dagobert the First, called "the great." Still, in the midst of all his grandeur and power, he worked as a goldsmith with his own hands, only assisted by his apprentice, Thillon, a Saxon.

In the time of St. Eloi there were three grades of goldsmiths—masters, companions, and apprentices. St. Eloi founded a monastery at Solignac, where he taught the goldsmith's art to his monks. After the death of his master, Thillon became abbot, and continued the teaching of the craft. St. Eloi also founded a convent in Paris, on a large piece of ground given him for the purpose, near where the Palais de Justice now stands. It was known as the Maison de Madame St. Aure (Aurata), from a virgin that came to Paris from Syria preaching the Gospel in Hebrew to convert the Jews. Perhaps she was chosen as first abbess on account of her name, for St. Eloi had his favourite art taught here also; and the convent became the centre for gold embroidery for church work. The

nuns were celebrated, not only for their exquisite work and the beauty of their designs, but also for the excellence of the gold thread they manufactured, which was purchased from them by all the world. The old accounts of this convent rather lead one to suppose that vessels and crosses for the service of the church were also made here; but I am not sufficiently sure that the nuns made them, to cite those nuns as women goldsmiths.

In Paris, during the reign of St. Louis, strangers were allowed to work as goldsmiths, after they had lived for a year and a day in the quarter of the Pont au Change or Grand Pont. If they were approved as craftsmen and good fellows—for all this time they must have been under the observation of the masters of the craft, who certified them to be respectable men and good workmen—they had to pay a tax to the king, according to the value of the custom they had; there was one Richardin, the enameller from London, who paid an impost of 3 sous; Robert, the Englishman, who paid an impost of 12 sous; and many other names of foreigners are recorded as having practised the craft at that period in Paris.

In the 11th century the monk Theophilus, who wrote on many arts, wrote a treatise on gold work, which, when all the odd superstitions about the preparation of gold are eliminated, evinces a knowledge, and a practical knowledge too, that would be hard to excel now.

Theophilus, whoever he was, and from whatever country he came (for these two details are not recorded, and the theory that he was of English birth never has been either proved or disproved), was a thorough master of all branches of the art; and a translation of his work will do more to help an amateur in his studies than any of the so-called technical hand-books ever written.

The treatise commences by describing how the factory—*fabrica*—should be built. He recommends that it should be large and spacious, should have a wide window, with a good light; he directs that there should be planks put round the table where the workers sit, to catch the pieces of gold that may fall in working. To the left of the worker a furnace must be built, of well-kneaded clay. He must have bellows, anvils, hammers, pincers, nippers, draw-plates, screw-plates, files, irons to scoop out the gold, to scrape it, to grave it, and to cut it. These “irons” are the great grandfathers of our scrapers, [split stickers

(*spelzsticker*), bull stickers, &c., used now. He does not mention “skins,” always attached to the board now-a-days, but probably the workers then wore leather aprons, which answers the same purpose.

This monk knew all the ordinary work. He tells how to begin and to finish cups for the altar, niello work, enamelling, and almost all the details of every branch of the craft; and all that he describes he did with his own hands, even to the building of the furnace. How many craftsmen are there who could do this now? Many of them can only do one thing, and that indifferently well.

Theophilus taught that a lad must be apprenticed for not less than eight years; then that another term was desirable, and that if all that could be learnt was to be acquired, a further term of pupilage must be spent, to make a first-rate master. Theophilus contended that it was necessary to be an apprentice for 21 years! In the Bibliothèque Nationale there is an engraving of Etienne Delaulne's Workshop, done by himself. Etienne Delaulne was better known as “Stephanus.” This engraving has been much copied, and the copies much used; it has even come down to be a frontispiece in a retail trade catalogue, but it is so very interesting that I asked my husband to prepare a slide for me from it, in order that I might point out to you the resemblance between a factory some five hundred years ago and one of the present day.

The Dictionarium of Magister Johannes de Garlandia gives some quaint accounts of customs in the trade, such as the rule that no master should be permitted to take a new apprentice before the one already bound to him was half out of his time, and that no master goldsmith should be permitted to take more than one outsider as an apprentice under any circumstances (by an “outsider” he means a lad, the son of a foreigner, or of a father who followed a calling other than that of a goldsmith).

The author of this dictionarium was of the noble family of Garlande; he followed William of Normandy into England. Both John Garlande and his Norman master were great patrons of the art; and I think Garlande could hardly have written as he did unless he could have worked himself, as well as describe the methods of work.

In all that concerns our subject the English were never far behind; there are Saxon jewels of great interest in the British Museum and in the Ashmolean Museum, there is King Alfred's

jewel, a drawing of which will be shown presently; at any rate the commercial spirit of the English was always manifest. It is related how English treasure helped the Abbé Suger out of a great difficulty. I should remind you that the Abbé Suger was Abbot of St. Denis, and minister to Louis VI. in the 12th century. Suger had prepared a magnificent gold crucifix and other ornaments for his abbey church, but for a long time after they were ready he could not obtain the stones he required to finish them, until when he began to despair three monks from England came to him to sell the jewels removed from the table cups of our Henry I., jewels that the king's nephew, Thibaut, Count of Champagne, had given to various convents to procure indulgences and prayers. How the jewels came into the hands of these three monks I am unable to tell you, but history says that the Abbé Suger bought from these men, for a sum equal to £400 of our money, jewels that were at that time of priceless value. The crucifix was melted in 1590 by the leaguers.

In the 11th and 12th centuries much gold was used in the manufacture of cups and decorations for sacred purposes; probably that is why so few of them remain now.

The gold on the Paliotto executed for that very interesting church in Milan, St. Ambrogio, by the goldsmith Wolvinus, was valued at 280,000 gold crowns; it is a most beautiful piece of goldsmiths' work, enriched with Cameii and Intaglii precious stones and enamel. Quintillian justly observes, "*Ars summa materia optima melior*," and the value of the exquisite design and arrangement of this work is far above the value of the material employed, yet the value is, in this case, so far above price, that there is an additional reason for being glad it is still preserved to us. Count Balzani told me how nearly it was lost when Milan was entered by the famished soldiers of Napoleon, and how it was saved by the adroitness of a priest, who knew that a small portion had either been stolen or lost, and that the vacant space had been supplied with a good imitation in copper gilt. This little accident was only known to a few of the priests, the outer world knew nothing of it. When the soldiers entered the church the priest advanced to them, asking what they wanted. He was rudely answered, "the gold altar case and the gems set in it." "Alas!" he said, "would that we had a gold altar, its value would supply the wants of many; it is this gilt Paliotto," he continued, "that you

must mean. Look! I will show you the gold." And he coolly broke away the restored copper gilt portion saying, "Do you think, if the gems ever were real, those here now are better than the copper? No, poor fellows, it is not in this bare, half-empty, poor old church that you will find treasure; go seek] it elsewhere." And they went without touching the Paliotto.

There is much to be said about art of the kind in our own and other countries, but there are some illustrations to be thought of, and, with your permission, they shall now be shown and described.

The paper was illustrated by a series of lantern slides, taken from fine historical examples of jewellery in the Gold Ornament Room of the British Museum, and other great national collections.

Slide.

1. Assyrian gold cup of beaten work, very sharp and characteristic; one of the finest old pieces of work now extant.
2. Funeral wreaths (Etruscan).
3. Bracelet, with *repoussé* figures, fibulæ, &c.
4. Etruscan ear-rings, ornaments to be sewn to garments, &c.
5. Etruscan necklace, heads of "IO," &c.
6. Etruscan necklaces, pins, &c.
7. Archaic Greek.
8. Archaic gold cup, &c.
9. Greek necklace, &c.
10. Greek necklace from island of Melos, &c.
11. Later Greek necklace, in form of stars, and Herculean knot in carbuncles.
12. Roman "marriage" brooch.
13. Early British torques.
14. Head ornaments, engraved; early British.
15. Byzantine cross, with Lord's prayer in the Cyrillic character.
16. Byzantine cross, with emblems of the "Passion."
17. Byzantine cross, and cross from Rheims Cathedral.
18. Anglo-Saxon ornaments.
19. King Alfred's jewel.
20. Reliquary from Royal and Imperial Treasury, Vienna.
21. Crown of Charlemagne, from Royal and Imperial Treasury.
22. Sword of Charlemagne, from Royal and Imperial Treasury, Vienna.
23. Arm bone reliquary, from collection Royal Irish Academy.
24. Cross of Corg, from collection Royal Irish Academy.
25. Fibulæ, from collection Royal Irish Academy.
26. Two views of a missal cover, from collection Royal Irish Academy.
27. One side of another missal cover, from collection Royal Irish Academy.

28. Shrine of St. Patrick's bell, from collection Royal Irish Academy.
29. Cross of Aberlemno.
30. Ornaments from Historical Museum, Munich.
31. Cellini pendant.
32. Gold and enamelled Mediaeval cup.
33. Cover of above.
34. Dagger and sheath (Holbein).
35. Venetian cross, from house of Marco Polo.
36. Workshop of Etienne Delaulne (better known as Stephanus), from the engraving by himself in the Bibliotheque Nationale, Paris.
- 37 and 38. From the Worcester casket designed by Mrs. P. H. Newman.
39. Mounting of opal cameo, designed by Mr. P. H. Newman.
40. Enamelled brooches, designed by Mrs. P. H. Newman.
41. Gold brooch, designed by Mr. P. H. Newman.

DISCUSSION.

Sir GEORGE BIRDWOOD, K.C.I.E., C.S.I., said he was not competent to speak on the subject of English jewellery, but he might, perhaps, be allowed to offer a few remarks on the admirable paper that had been read to them in its references to Indian and Oriental jewellery generally. Probably Mrs. Newman in saying that pure gold could not be worked meant gold chemically pure, that is without any alloy, for in India the natives always insisted on 24 carat gold being used in their jewellery, and they were very skilful in detecting the quality of gold, though they did so only by means of the touchstone. He himself, from constant practice and observation, was pretty well able to judge of the quality of gold, and he knew that 24 carat was the quality habitually used in the best native Indian jewellery. Their own description of it was "pure gold as soft as wax." He thought Mrs. Newman would find India a far more profitable hunting ground for the secrets of the ancient methods of working gold than China. There was a theory that the Chinese had largely derived their arts and civilisation from the banks of the Euphrates and Tigris, but he felt sure that more ancient goldsmiths' lore remained in an unalloyed condition in Southern India than in any other part of the world. Some of the jewellery made in the temples of Southern India could scarcely be distinguished from the Etruscan examples which had been shown them by Mrs. Newman. He might refer not only to the examples, not of the best kind, in the South Kensington Museum, but particularly to Mr. Havell's illustrations in Mr. William Griggs's *Journal of Indian Art*. There was one necklace illustrated in that journal, bearing a number of pendants, each one distinct from every other, and all perfectly artistic in shape, and elaborated with the most beautiful details. Mrs. Newman said there had always been a separation between secular and religious

jewellery, but that was not the case in India, nor, so far as he knew, in any part of the Oriental world before the introduction of Christianity. When Oriental art passed from Asia into Europe it lost a good deal of its original religious significance. But all art had originated in religion, and in India—India of the Hindus—there was no distinction between secular and religious art. In Southern India the Hindu jewellery was almost all done in the workshops of the temples, and it was the best jewellery in the world at the present moment. The decay of the jewellers' art in England, since 1832, was always a puzzle to him, for he could not believe it was due to any want of artistic instinct in the people. We had in previous ages shown ourselves as great as other nations in all branches of applied art; and he could only suppose the cause of the present decay was owing to our energies being absorbed in other things, as in mechanical invention, in commercial enterprise, and in these last years of the century, in politics. It was pleasing in the midst of all the ignorance and confusion which now prevailed in the political world, to find that the unexhausted energies of our women were being so generally devoted to art. He hoped they would long continue in this peaceful, upward path, thereby conferring untold benefits on the present and future generations, and avoid the broad, downward road of politics, as they would poison.

Mr. S. B. WEBBER said it was very painful to contradict a lady, but he must emphatically assert that there was no real difficulty in working absolutely pure gold. This could not be produced by the ordinary process of refining, and what was ordinarily called pure gold was 23 $\frac{1}{2}$, or 23 $\frac{3}{4}$ carats fine. Chemically pure gold must be produced by other means, and such gold he had worked. There was a little more difficulty, but nothing which could be called a real difficulty. He thought one of the pictures shown represented the Tara brooch in the Dublin Museum, perhaps one of the most beautiful pieces of work ever fashioned by the hand of man. He did not say it possessed the design of Cellini's works, but for intricacy, and the marvellousness of such a combination being put together without solder, it was unrivalled. He had been much delighted to see so many specimens of Irish work, undoubtedly ancient, dating from a time when Ireland was in a state of civilisation, perhaps in advance of the present. There was an immense deal of ancient metal work in Ireland, in copper, or bronze, or brass, quite equal to the gold, though neither its uses nor the manner in which it was made were at all understood.

Mr. CAVE THOMAS regretted that, owing to his deafness, he had not been able to hear the paper, but he knew that Mrs. Newman thoroughly understood the subject, and he had no doubt she had dealt very ably with it. He had studied ancient Assyrian and Greek goldsmith's work, and found a great

sameness running through it. He did not find that gold and silver ornament, as we understood it, with the variety of modelling now found in jewellery, came much before the 14th and 15th centuries.

Mr. HUGH STANNUS, after expressing the great satisfaction it gave them to have so able and practical a paper by a lady, said with regard to the question of hammering gold, it was interesting to note that the colossal bronze statues of antiquity were most of them produced by hammering. They could not possibly be produced, in those early times, except by hammering; and they were termed "torentic." They were hammered out of sheets, and rivetted together. This work may be produced in one of two ways: either by hammering the metal-sheet on to cover a core of wood, which he would term the *positive* method; or by hammering and pressing the sheet into a matrix of wood, which he might term the *negative* method. The method of joining the different plates of the early statues was by nailing or rivetting into the wooden core. With regard to that beautiful work from Ireland, the authorities seemed to hold that the art-tradition had travelled from Byzantium, across Eastern Europe, into the Baltic, so to Scandinavia, thence to Iceland, and Ireland. That accounted for the strong Byzantine character in all Scandinavian work. Doubtless it went from Denmark through the monks: there would not be sufficient inducement for traders to go so far; and one was glad to think that it was in the cause of religion, and the desire to spread Christianity. In regard to the remarks depreciatory of modern work, he begged to be allowed to suggest that it was scarcely fair to compare our present work, which was done at so much an hour, and sold at so much an ounce, with that done by these monks, men of leisure, who had all the gold of their neighbourhood at their disposal, and did all to the glory of God. Of course, compared with what they did, any work we might do now was miserable and poor. A man who entered his monastery in middle life, when he had seen the "vanity of earthly things," but still having the knowledge of his craft, devoted all that remained of his life to make one shrine; and if it were not done, when he grew old or died, then one of the younger monks, whom he had taught, completed it. Some of these things took many years to make. There were inscriptions—"Made by *so and so*, the son of *so and so*, and by *so and so* the son of *so and so*," thus showing that part of the lives of two men had been devoted to one object. With regard to the loss of the old apprenticeship system, no one regretted it more than he did; but he feared they must reconcile themselves to that; and seek to replace it by technical education. When in Birmingham some time ago he visited the technical school, and saw the way in which the young people were taught soldering and bending metal to make cloisons, and various other operations of goldsmiths' and jewellers' craft, and he was exceedingly interested in

it. It appeared to him that they were on the right tack, if they could only get the apprentices to stay long enough. Mrs. Newman had laid stress on work being done *cold*; and most of it was interesting, and much was beautiful; but he thought that soldering was the most important of the mechanical operations in goldsmiths' work. Indeed, he would venture to say that the man who invented solder really invented goldsmiths' work, for all the great successes in it had been rendered possible by the operation of soldering; and without it there would have been none of the later objects in our museums. He desired to be permitted to add his thanks for the paper, and for the series of interesting illustrations which Mrs. Newman had commented upon in so practical a manner.

Mr. C. KRALL said he recollected the time when he was an apprentice on the Continent, where everything had to be done in a small place by a few men. There everything which was shown in high relief was first modelled, mostly in clay or wax, afterwards it was cast in zinc or some such metal, and over this zinc, which represented the work in relief, the gold was hammered. He thought it scarcely possible that in olden days they could have made use of a wooden matrix for beating plates of gold into, and just as little could they have been beaten out in relief for figure work without having a relief of something like wax or clay before their eyes. Even in the present day, when gold work had to be made in very thin material, it was much safer to handle it over a model in relief in place of driving it into a concave. Mr. Stannus had alluded to the great progress rendered possible by means of soldering, and he would also point out how much the process of soldering had been facilitated by the invention of gas. Many could recollect the time when they had to deal with a big oil flame and a large blow-pipe to direct it. In some cases the metal prepared for soldering was put into charcoal, and then heated generally by fanning the flame. Very often it could not be properly regulated, and became too powerful in a particular portion, and thus work was often spoilt. Through the introduction of the gas jet all these difficulties were overcome. With regard to the early development of goldsmith work and enamelling in Ireland, he suggested the possibility that Phœnicians who came to this and the neighbouring coast for tin had sometimes been left behind and passed the winter in these islands, and there practised the arts which they followed in their own country.

The CHAIRMAN said it was his privilege and pleasure to offer in the name of the meeting a hearty vote of thanks to Mrs. Newman for her interesting and instructive lecture. Whatever their views might be with regard to ladies taking part in politics, they could have no doubt of the propriety and advantage of ladies engaging in so interesting and highly intellectual a subject as this. He cordially endorsed Sir George Birdwood's hope that more ladies would interest themselves in similar pursuits, because they would be

largely instrumental in promoting the information and progress of the community. He could not sit down without calling attention to the fact that they owed to Mrs. Philip Newman the pleasure of seeing the delightful views which had been shown; she had procured them with much difficulty and trouble, and had shown much taste in their arrangement. The subject of ornament was very large, much too large to deal with, even in one evening, and he would only remark that but scant reference had been made to the greatest goldsmith perhaps who ever lived in the world—Cellini. Love of ornament was universal, probably the only absolutely universal feeling amongst men, and it was to be found amongst all classes in all regions, and in all conditions of human life, and it was not even confined to the human race. If one went to the charming museum at South Kensington and saw there the bower bird gathering together the beautiful stones, feathers, and other little objects, in order that he might make the home of his lady love attractive, they would recognise that the sense of ornament and the desire to combine it in a home, and the consciousness that it was likely to give pleasure to another, was a feeling that was not exclusively connected with human beings, but enjoyed by this bird, at any rate, and probably by other animals in a more or less degree. In the early part of the 15th century the rulers of Florence established a law that women should not be allowed to exhibit on their persons precious stones or objects of jewellery. That was probably a reaction from the excess of luxury which had obtained before. But, at all events, under some possibly Republican spirit that law was introduced, and it operated for a very long time, but he could not think it was very rigidly carried out, because they saw in the pictures of that period, representations made of very superlative work indeed, which showed that long before the time of Cellini—who was born in 1500—there were artists in jewellery of very high talent, and, indeed, some of the work before Cellini's time was altogether worthy of him. Possibly there were some present who had not read the autobiography of Cellini; if so, he would recommend it to them as one of the most interesting works ever written. It was difficult to exaggerate its interest and value, as showing the character and the tastes of the Italians of the cinquecento period. He stated that at the age of 16, so great were his natural gifts, that he found himself able to produce work of a higher order of excellence than most of the highly paid workmen in the shops in which he was employed, and he continued up to the age of 70, when he died, to produce works which were altogether the most beautiful, the most perfect, the most delightful, that ever human hands produced. He did not mean to say that amongst the real Greek work there were not works of perhaps more technical difficulty produced, because he did not understand the art practically, but certainly with regard to design, perfection, complication, minute detail, and the singularly beautiful conception and

appreciation of what was the best thing to do under the given circumstances, Cellini exhibited a facility of taste, a charm of sentiment, and a singular faculty of dealing with the precious metals and such as no other artist exhibited. There were many others, such as Holbein, to whom he might refer if time allowed. Towards the latter part of the 16th century the art seemed to fall into decadence, and from that it never recovered, but perhaps the most distinguished men who succeeded him, though a long distance off, still produced work of a highly remarkable kind. At Dresden there were works by Jamnitzer, Dinglinger, and others of singular skill, showing remarkable technical power, but at the same time rather extravagant, altogether opposed to the more refined canons of taste, such as marked Cellini's work. One of the most remarkable things he had seen lately with regard to the application of pearls was in the South Kensington Museum, in the Spanish section, where there was in wax a model of St. Sebastian with an angel by his side. The whole of the two bodies were covered from head to foot with very minute pearls, which gave a granulated effect to the skin of a very remarkable kind. He did not know if the game was worth the candle, still it was worth looking at. He should like to have referred to Castellani, whom he had the honour of knowing, and to some of the delightful things he showed him in Rome, but time would not permit. He would remind them of a passage in the "Merchant of Venice" in the casket scene:—

"So may the outward shows be least themselves;
The world is still deceived with ornament."

When he saw the remarkable multiplication of shops in London selling false jewellery, he was sorry to find that the world was going to be deceived very much indeed with ornament. He could not understand how any honourably-minded man, or any woman, could condescend to wear false jewellery. To his mind it showed a lack of morality to pretend to have what you could not afford to buy if it were real, and the use of that which was spurious seemed to him a custom to be reprobated by every thinking person. In the Palais Royal there was plenty of false jewellery, but amongst it was some jewellery of a simple kind; it was highly artistic, and could hardly be called false, because it did not deceive any one as to its real character. It was made of a kind of oxidised silver, in which the most beautiful things were produced at a very small cost. There was no objection to ornaments of that sort if they were artistic, and deceived no one.

The vote of thanks was carried unanimously.

Mrs. NEWMAN, in responding, said she must still adhere to her statement that it was not practicable, even if it were possible, to work in absolutely chemically pure gold. It would not last long enough to make it worth while to expend time upon it.

The following letter from Mr. E. W. Streeter, of 18, New Bond-street, was printed in *The Times*, 2nd March:—"The opinions expressed by Mrs. Philip Newman in her lecture delivered at the Society of Arts and reported in *The Times*, will meet with cordial endorsement from all who are, like myself, interested in goldsmiths' work. This applies more especially to her remarks on the subject of apprenticeship. Mrs. Newman makes a slight error, however, which I think it is worth while to rectify, in stating that 22 carat gold is the highest standard that can be reached. I have for many years tried to work pure gold, and have succeeded in making solid gold articles of $23\frac{7}{8}$ carats, or only one-eighth of a carat less than absolutely pure gold—viz., 24 carats."

FOREIGN & COLONIAL SECTION.

Tuesday, March 6, 1894; Capt. V. LOVETT CAMERON, R.N., C.B., in the chair.

The paper read was "Travels in the Basin of the Zambesi," by EDOUARD FOA.

The paper and discussion will be printed in next week's *Journal*.

FOURTEENTH ORDINARY MEETING.

Wednesday, March 7, 1894; R. BRUDENELL CARTER, F.R.C.S., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Barber, James, Encombe, Endlesham-road, Balham, S.W.

Gowland, William, 35A, Russell-road, Kensington, W.

Meaby, Michael Charles, St. Luke's Vestry-hall, City road, E.C.

Middleton, Richard John, 18, Finch-lane, E.C.; and 15, Balfour-road, Highbury, N.

Pettigrew, George, St. Paul's-road, Middlesbrough.

Pilditch, John Thomas, 12, Cambridge-road, Battersea-park, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Kent, Walter G., 199, High Holborn, W.C.

Niven, David Coats, Oriental Gas Company, Calcutta.

Walker, Ernest Octavius, C.I.E., Brook-hill-house, Teignmouth, Devon.

Walton, Joseph, Zetland-buildings, Middlesbrough.

Williamson, G. H., Mayor of Worcester.

The paper read was—

REFRIGERATING APPARATUS.

BY PROF. CARL LINDE

(Of Munich).

The results of recent investigations on low temperatures have never before been brought under public notice in so complete and comprehensible a manner as has been done by Professor Dewar in his lectures on the liquefaction of gases, investigations commenced by Faraday and continued by a number of physicists, but in no case with greater success than by Professor Dewar.

I will select from those lectures only the description of a method by which it is possible to liquefy the substances called up to recent times permanent gases, especially the constituent parts of atmospheric air (oxygen and nitrogen). If we take a drum filled with liquid carbonic acid (as obtainable in commerce) and allow the carbonic acid to pass into a vessel (Fig. 1) in which atmospheric pressure is maintained, the carbonic acid will boil at -80°C . (-112°F). If we now compress ethylene vapours by means of a compression pump into a second vessel placed inside the first receptacle, it will liquefy, and on allowing the liquid ethylene to enter a third vessel, inside which atmospheric pressure is maintained, the boiling point of the liquid will be about -100°C . (-141°F); if, however, the pressure were to be reduced, then the boiling point of the liquid could be lowered to -140°C . (-220°F). If, further, by means of a second compressing pump, oxygen be compressed into a closed vessel placed within the ethylene vessel, liquid oxygen is obtained, boiling under atmospheric pressure at -180°C . (-290°F), and by reducing this pressure the last named temperature can be lowered to -200°C . (-328°F) at which point atmospheric air will condense on the surfaces of the vessel, even when not compressed.

Here then is a way opened for technical enterprise, enabling us by methods now fully available, to produce and maintain temperatures below -200°C . (-328°F) and not far distant from absolute zero, which we know physical science to place at -273°C .

The uses to which industry may put this discovery cannot as yet be certainly defined. The lowest temperature hitherto employed for industrial purposes is -110°C . (-166°F), a temperature utilised to distil in vacuo the subtlest constituents of certain organic substances, and to produce them in this manner of a purity hitherto unknown.

Excepting these isolated applications, the temperatures, for the creation of which the

industry of to-day employs refrigerating machines, do not lie greatly below the freezing point of water, and in at least 95 per cent. of all applied cases, there is a demand only for temperatures above zero Fahr. But inside this narrow temperature range, refrigerating machinery has found within the two last decades an application so extensive and manifold that it would take an entire evening to enumerate and describe them briefly. Probably no other branch of mechanical industry, with the exception of electricity, has developed so rapidly during that time. Our industries may avail themselves of a number of machines and apparatus which are capable of creating and maintaining in an entirely reliable manner the desired temperatures. Those who require refrigeration need not to-day consider the question of the machine system supplying the cold in a reliable and regular manner, but they will seek to find the machine which

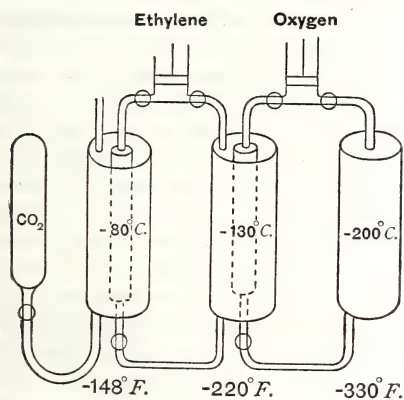


FIG. 1.

will accomplish this in the most economical way; that is to say, the machine which will produce a given amount of cold with the least expenditure of work (or fuel) and of water.

I now propose to make a comparative review of the methods and the economical value of the working processes as they are performed by machines and apparatus chiefly in use at the present day.

The first attempts to construct such machines and apparatus were made with reference to certain isolated physical phenomena, and efforts were directed towards the utilisation of these without any explanation being available as to the relation between the production of cold and the requisite expenditure of heat or mechanical work. It was only subsequent to the development of the mechanical theory of heat, and the application of its laws to the

contemplation of the caloric processes in such machines, that inquiries could be made with success as to this connection between production and consumption. The following questions could then be put:—

1. What efficiency (relation between production and consumption) is really obtainable?
2. What is the working process permitting the attainment of such results?
3. What position do the existing refrigerating machines hold with regard to the foregoing points?

Here we have to start with the consideration that the production of cold is a process by means of which heat is abstracted at a temperature below that of our surroundings, and—seeing that its annihilation is impossible according to the principle of the conservation of energy—raised to such a temperature-level that it can be transferred to surrounding parts (for instance, to the atmosphere or to water,

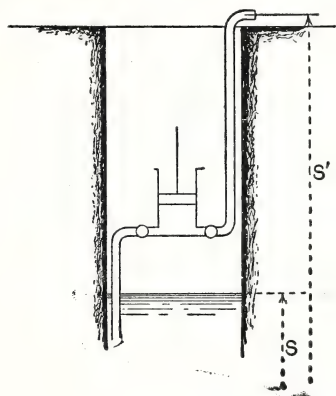


FIG. 2.

briefly termed further on, "cooling-water"). We may compare such a process to the action of a pumping-engine having to keep the water in a shaft at a certain level by raising all in-flowing water to a height from which it may flow away. (Fig. 2.)

The raising of heat from a lower to a higher temperature (and it is herein that the action of a refrigerating machine consists) can, like the lifting of water, be effected only by the expenditure of a certain quantity of mechanical work. Concerning the amount of this work, we are taught by thermo-dynamics as follows:—

If T be the temperature at which the heat is to be abstracted, and its quantity, H , heat-units, and if T' be the temperature at which the heat can be transferred to the cooling-water, then there will, for this purpose, be required a quantity of work, W , determined

by the first law of thermo-dynamics by the relation—

$$A W = H' - H \dots\dots\dots(1)$$

Herein A denotes the thermal equivalent of work and H' the heat discharged at the temperature T' . The foregoing relation expresses therefore that the discharged heat, H' , is equal to the abstracted heat, H , plus the equivalent of the mechanical work expended, seeing that this latter, imparted from outside, cannot disappear, but must be transformed into another form of energy, *i.e.*, in this instance, heat.

Assuming that the heat, H , be abstracted exclusively at the absolute temperature T , and that H' be rejected exclusively at the absolute temperature T' , the second thermo-dynamic law expresses that the heat-quantities, H and H' , are proportional to the temperatures, T and T' , thus:—

$$\frac{H}{T} = \frac{H'}{T'} \dots\dots\dots(2)$$

or by inserting the value of H' into the relation (1)—

$$A W = \frac{H}{T} (T' - T) \dots\dots\dots(3)$$

The last formula expresses that, for the purpose of abstracting the quantity of heat, H , at T degrees (or in order to produce H heat-units of cold) and raising it to the level T' , a certain number of work-units, W , are requisite, if working with a perfect engine without any losses whatever.

I now explain this connection graphically.

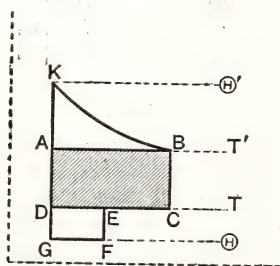


FIG. 3.

If in Fig. 3 the absolute temperatures are plotted as ordinates, and the values of $\frac{H}{T}$ and $\frac{H'}{T'}$ as abscissae, then the equivalent of the work will be represented by the rectangle ABCD, the length of which is $\frac{H}{T} = \frac{H'}{T'}$ and the height $T' - T$. For a given temperature, T , the minimum work corresponding to the production of a certain quantity of cold, H , is directly proportional to the difference of temperature, $T' - T$.

After just having compared the process of producing cold with lifting a weight of water, we now find a complete analogy to exist for the relation of the terms expressed by work. Referring to Fig. 2 we find the theoretical work for pumping to be:—

$$W = G (S' - S),$$

G denoting the weight of water lifted. We recognise a complete identity, if G be put equal to $\frac{H}{T}$, and in consequence of this analogy

the term $\frac{H}{T}$ (designated in physical science as "entropy") has been called "heat-weight." In passing, I may point out that seemingly a difference does exist, because the heat-weight $\frac{H}{T}$ of a certain heat-quantity varies with the temperature T , whilst G is considered as a constant value. But if we consider that $G = m \times g$, and that g (the acceleration by gravity) increases, as the mass, m , approaches its centre of attraction, that, consequently, also G is really variable, and that we are accustomed to consider G as constant only because the values of $S' - S$, with which we have to do, are relatively very small, as compared with the distance to the centre of attraction, then we find indeed a complete analogy, provided we place the absolute zero and the centre of attraction side by side. In our caloric processes, however, the difference $T' - T$ is by no means infinitely small in comparison with T , and thus the latter must be taken into account.

By keeping in view the analogy between the performances of our caloric engines and those lifting weights, it is possible to demonstrate the working process of each single machine in a simple and intelligible manner, and to obtain a correct representation of the nature and value of these processes, even without mathematical deductions, which render to many the study of thermo-dynamic problems a matter of difficulty.

The consideration of the working process of the most important existing refrigerating machines has been selected by me as the special subject of my present paper. Let us consider again more closely the equation—

$$A W = \frac{H}{T} (T' - T).$$

It holds good, on the assumption that the abstraction of the entire heat-quantity, H , be performed exclusively at the temperature T , and that the corresponding heat-quantity, H' , be rejected exclusively at the temperature, T' . In the event of part of the heat being ab-

stracted, not at T , but at a temperature higher or lower; if, for instance, only the part EC (Fig. 3) of the heat-weight be abstracted at T , whilst the heat-weight, FG , be abstracted at θ , then the work to be expended would be represented by the area $ABCEGF$; or if the rejection of heat took place, not at the constant temperature, T' , but a rising temperature corresponding to the line, BK , then the increase of work to be expended will be indicated by the area, BKA .

We perceive that a consideration of the formula $AW = \frac{H}{T} (T' - T)$ permits of an immediate answer being given to the questions raised.

1. It conveys to us the amount of theoretical work requisite for the abstraction of a certain amount of heat at a given low temperature, T , and for its rejection at a given higher temperature, T' ; in other words, how many thermal units of cold at certain conditions of temperature can be produced per working unit, or say per horse-power.

2. It teaches us that the working-process enabling us to attain this most favourable efficiency, must be conducted in such a manner that at no single point heat is abstracted at lower temperatures than those strictly determined by the given problem, and that the heat must not be lifted any higher than is absolutely necessary for its rejection to the cooling water. A process satisfying these demands is termed a perfect process.

I now, on the basis of the preceding data, pass on to the investigation of the third question—How do the existing refrigerating machines correspond to the results theoretically obtainable?

The classification of refrigerating machines into three groups is well known, namely, those in which the refrigeration is based upon the *expansion of atmospheric air*; and those basing the production of cold upon the evaporation of a volatile liquid, the return to liquid state being effected either by *compression* or by *absorption*.

Fig. 4 represents the cold-air machine as

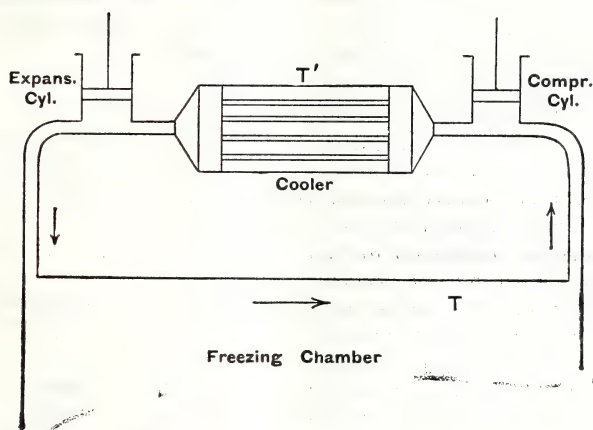


FIG. 4.

usually now employed, and we will assume that the freezing chamber, R , has to be maintained at the temperature T . The compressor draws in air (wholly or partly out of the chamber, R) and compresses it to about three or four atmospheres, the work of compression being simultaneously converted into heat and the air being heated to the temperature θ . By means of direct or indirect contact with cooling water this air is reduced, as near as possible, to the temperature T' of the cooling water, and is then admitted into an expansion cylinder, there expanding to atmospheric pressure;

hereby the equivalent of the work expended upon the expansion piston is abstracted from the air and its temperature is accordingly lowered to a certain temperature θ . The air enters the freezing chamber R at this latter temperature, and abstracts heat from the air in this chamber by being heated from θ to T .

How far does this performance correspond to the conditions of the perfect process? The problem set to the machine amounts simply to maintain the room R at the temperature T , *i.e.*, to abstract all heat developed in this chamber or entering it from without, at the tempera-

Zeuner, as they represent simply the reversal of a steam-engine. The liquid (sulphurous dioxide, ammonia, carbonic acid, &c.), enters the coils of the refrigerator, evaporates in them, and thereby abstracts the heat necessary for evaporation (latent heat) from the surrounding liquid (brine for instance) at the temperature T .

The vapours thus generated are aspirated by the compressor and forced into the condenser at a pressure corresponding to the temperature T' , at which the transfer of the latent heat to the cooling-water is rendered possible. The condensed liquid returns by the regulating valve into the refrigerator. Let us now ask to what extent does this process satisfy the conditions which we have found to constitute the perfect process.

The abstraction of heat is performed in the refrigerator at the temperature T (Fig. 7). The compressor then lifts the heat without any addition or removal of heat (*i.e.*, adiabatically) to

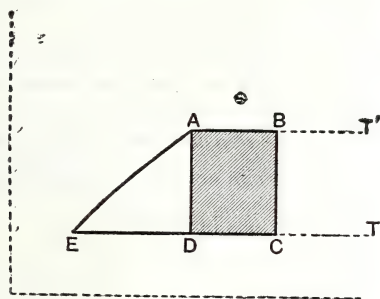


FIG. 7.

the temperature level T' , whereupon it is transferred to the cooling-water at this latter temperature. Thus far the process corresponds to the conditions specified. As regards the return to the lower temperature T , this should be performed without addition or rejection of heat (*i.e.*, under adiabatic expansion), but as the liquid streams under the influence of the pressure p' through the regulating valve into the refrigerator standing under the pressure p , its liquid heat is reduced from $q' H U$ to $q H U$ and this heat $(q' - q)$ abstracted at decreasing temperature (A E) is employed to evaporate part of the liquid before its entrance into the refrigerator. There will be thus imparted to the refrigerator the liquid heat $q' - q$ at the temperature T corresponding to the refrigerator-pressure p (E D).

I am neglecting here, as being comparatively small, the equivalent for the work corresponding to the transit of the liquid from the pressure

p' to that of p , which strictly should be added. Hence we have, as a fact, that the weight-unit of volatile liquid flowing from the condenser to the refrigerator enters the latter as a mixture of liquid and vapour, the vapour-part being $\frac{q' - q}{r}$, if r denotes the latent heat of the

weight-unit at the temperature T .

The greater, therefore, $q' - q$ as compared with r , the greater will be that portion of the aspirated and compressed vapours which arrives at the refrigerator already in the state of vapour, and the smaller will become that part of the aspirated vapours which has been formed in the refrigerator, and has abstracted heat from the surrounding brine. Only the removal of the last-named heat can be regarded as useful refrigeration, but the work of compression has to be performed not only upon the vapours usefully developed in the refrigerator, but also upon the vapours represented by $\frac{q' - q}{r}$, the formation of which does

not contribute to useful refrigeration. Consequently the total requisite work of compression is increased closely in proportion to the ratio $\frac{q' - q}{r}$.

Whilst for the perfect process the nature of the volatile liquid is entirely immaterial, we find for the process, as actually carried out, the efficiency to be dependent upon the ratio between liquid heat and latent heat, and in this respect the various liquids in use behave very differently. I should now like to deal with this more fully.

If we intend to transform any liquid possessing the temperature zero into saturated vapour of the temperature t , we have to convey to the weight-unit of liquid an amount of heat termed "total heat," and composed, firstly, of the liquid heat, q ; that is, the heat necessary to raise the temperature of the weight-unit from zero to t^0 , and, secondly, of the latent heat, r , that is, the heat necessary to convert the weight-unit of liquid of the temperature t , into saturated vapour of the temperature t under the pressure corresponding to this temperature. If we plot in a diagram (Fig. 8) the temperatures as ordinates, and as abscissæ, both the liquid heats (q) and the total heats ($\lambda = q + r$), we obtain curves leaning away continuously from the ordinate line in their upward course, because both heats increase with increasing temperatures.

The accompanying figure represents these

values for the two most important volatile liquids, ammonia and carbonic acid; and we recognise at first sight that for ammonia the values of r are relatively far greater to those

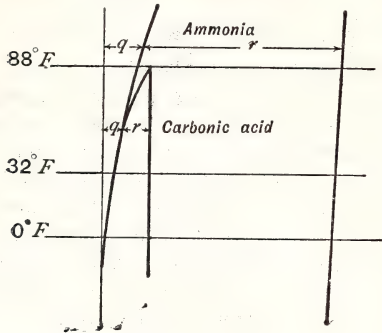


FIG. 8.

of q than for carbonic acid. We even notice the fact that, for a certain temperature, r is reduced to nought, such temperatures constituting the so-called "critical temperature."

The following considerations will show that such must be the case:—If in a diagram the temperatures be plotted as ordinates, and the specific volumes (the volumes of the weight-unit) of the liquid and of the saturated vapour as abscissæ; $a b$ will represent the curve relating to the liquid (the volumes of the liquid increase with the temperature); and $c b$ will denote that for the saturated vapours (the specific volumes of these decrease with increasing temperature). Thus there must exist a temperature at which the volumes of the liquid and of the saturated vapours coincide, i.e., at which no change of volume is involved for the transition from the liquid state to that of saturated vapour, and at which, consequently, the requisite demand for latent heat is nought.

It follows that the refrigerating efficiency of a cooling machine, in which the volatile liquid is conducted to the regulating valve at the critical temperature, is reduced to nothing, as long as saturated vapours only are withdrawn. because in this case the liquid heat, $q' - q$, equals the latent heat, r . But if the vapours are brought to the refrigerator with a temperature of θ (Fig. 9), lying far below that of the brine, T , then they may be enabled, by assuming the superheated state, to abstract from the brine a certain (specific) heat, and to maintain some amount of refrigeration. Fig. 8 represents the work theoretically required by the area, $A B C D$, whilst the area, $A B C E F$, expresses approximately the actual expendi-

ture of cost, if all losses from other sources be neglected.

It will be clearly recognised from what has been said that it is disadvantageous to employ in a compression machine a volatile liquid possessing its critical point within or close to the temperature range within which the working-process is performed, because in such a

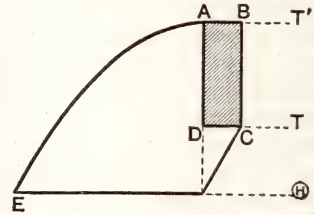


FIG. 9.

case the liquid heat $q' - q$ is relatively great in comparison to r . If, on the contrary, a volatile liquid be selected, for which the ratio between these two heat-quantities is small, for instance ammonia, then the process, as performed in a compression machine, approaches the theoretically perfect performance so nearly, that, according to incontestable proof, up to two-thirds of the cold determined by the relation $\frac{H}{A W} = \frac{T}{T' - T}$ can actually be obtained under ordinary conditions of working.

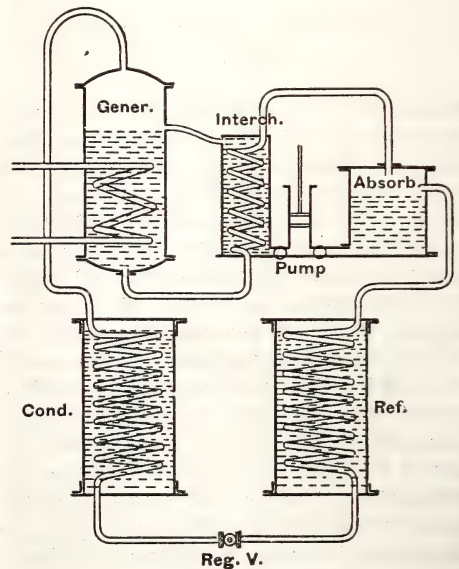


FIG. 10.

The third group of refrigerating machines—absorption machines—have a condenser, a

regulating-valve, and a refrigerator, just as in the case of the compression machines; but the compressor is substituted by a combination of other elements, whose functions, I believe, are well known. The ammonia vapours are, in the first place, absorbed by a weak solution of ammonia in water, which, after having been saturated, is pumped into the generator, exchanging on its way its temperature with that of the weak solution coming from the generator. The temperature in the generator is then raised by means of heating (mostly done by steam), to such a degree that the ammonia is driven out from its solution, and that the corresponding pressure of the developed vapours is sufficient to force them into the condenser, where they are liquefied at the temperature T' .

The working process is, therefore, identical with that of the compression machine in the following points:—At the constant temperature T' in the condenser, the latent heat r is rejected ($A B$ in Fig. 7), then the liquid heat $q' - q$ is given up at temperatures decreasing from T' to T ($A E$ in Fig. 7). Entering the refrigerator the ammonia abstracts from the brine the latent heat r , minus the liquid heat just referred to. In this way the useful cold $r - (q' - q)$ is produced just as in the compression machine.

The return from the temperature T to the temperature T' is, however, not affected by direct compression. The vapours are not raised to the necessary pressure for liquefaction by the action of a piston, but in an indirect way by means of absorption and distillation. The same mechanical work is to be done in either case, only the nature of the performance is different. Instead of compression by a piston the volume σ of the liquid ammonia is transformed in the generator to the volume v by heating under the pressure p' necessary for liquefaction, thereby the mechanical work $p'(v - \sigma)$ is performed. This work is equal to that to be done in the compression cylinder.

The fact that in the absorption machine the work is produced by the direct application of heat makes the comparison with the compression machine somewhat difficult. The refrigerating machine and the motor may be taken as being combined in the absorption machine. For comparison with the compression machine the latter must be supposed to be driven by a heat motor, say a steam-engine, and both, *i.e.*, the heat motor and the compressor are to be considered as one unit side by side with the absorption machine. The

question is now—How many heat units must be expended for the production of one thermal unit of cold?

For the compression machine we had—

$$\frac{A W}{H} = \frac{T' - T}{T}$$

It is well known that in order to produce the work W in a steam-engine a far greater amount of heat has to be expended than $A W$, because only one part of the expended heat can be transformed in mechanical work. If, for instance, we have to deal with a steam-engine with a consumption of 14 lbs. of steam per horse-power hour, the proportion of $A W$ to the actual consumption of heat H_s will be about 1 : 6.33, and we have for the expenditure of heat to produce a certain amount of cold H , the equation:—

$$\frac{H_s}{H} = 6.33 \frac{T' - T}{T}$$

If the value of $\frac{T' - T}{T}$ is entered in a diagram (Fig. 11) as abscissæ (T' taken as

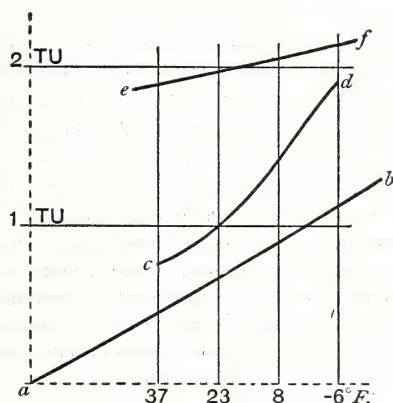


FIG. 11.

68° F.), and the value of H_s (H taken = 1) is entered as ordinates, we get a curve ($a b$) which represents the theoretical minimum of H_s . In a second curve ($c d$) were represented those heat-units H_s which are actually measured in the ammonia compression machine tested at the trial station of the "Polytechnischer Verein" in Munich.*

How do absorption machines behave as compared with this result? We have seen: the cold produced per lb. of ammonia circulated is—

$$H = r - (q' - q).$$

In the generator, without considering the water carried through the process, heat must

* See "Bayerisches Industrie und Gewerbeblatt," No. 25, 1893.

be expended as follows:—The latent heat (r'), plus the heat of absorption (a), and plus the specific heat (c) necessary for the superheating of the ammonia vapours from the temperature, T' to θ' .

The result therefore is—

$$\left(\frac{H_s}{H}\right) \text{ min.} = \frac{r' + a + c(\theta' - T')}{r - (q' - q)}$$

If we now plot in our diagram (Fig. 11) the values of H_s , corresponding to the temperatures represented by the abscissæ, we get the curve (ef).

By comparison of these three curves, it is evident that the performance of the required mechanical work can be done much more economically in a compressor than by means of the system of absorption and distillation, even if an apparatus could be constructed for the performance of this working principle working without any losses whatsoever.

DISCUSSION.

The CHAIRMAN said he presumed the basis of economy in manufacture must be a right appreciation of the principles upon which the various processes to be performed were based; and, if that were so, all who had to benefit by a manufacture, either by conducting it, or by using its products, were greatly indebted to those philosophers who made abstruse calculations to guide those who were engaged in carrying out the processes. They were, therefore, much indebted to Professor Linde, who had given proofs of his exact practical knowledge on this subject, by inventing a very excellent refrigerating machine, and they would all join in tendering him a hearty vote of thanks for his paper.

Mr. L. STERNE being called upon, said the paper was most interesting, but, being purely theoretical, he was not able to say anything about it.

Mr. W. W. BEAUMONT said they had to thank Professor Linde for a really valuable paper, containing a great deal of important information—the result of his own researches—though, at the same time, he did not know that it contained any striking novelty, or any points which he had not dealt with in previous papers. Probably many present would be better able to speak on the subject from the practical or commercial side, which had not been touched upon. Few probably had any idea of the magnitude of the traffic now carried on by cold storage vessels, or of the continually greater and greater extent to which they were looking to foreign countries for the supply of food to the country, owing to the use of such vessels. Refrigerating machines had been much more amenable to scientific treatment on the thermo-

dynamic side than almost any other class of machines. They had long been accustomed to see steam-engines and other motors submitted to this kind of examination, but he was not sure that the steam-engine had been much improved in consequence; but it was perfectly clear that refrigerating-machines had gained in every way by such treatment, as had been so ably described. The point referred to as the difference between latent heat and liquid heat was one which lay at the bottom of the most important recent advances, but without going into that he would ask to what extent recent practice had shown that the theoretical difference in economy between the different classes of machines had been borne out. Even now air-engines were still being constructed, and quite recently he had seen a large set of them being prepared for a large ship; there must be some reason for continuing the use of machines which, theoretically, were so much less efficient than others. Of the other two kinds, again, each found supporters amongst people who, apparently, knew what they were about; and one would like to know whether they were practically as different as they appeared to be theoretically.

Mr. MATHESON said it would be interesting if Mr. Stern would state how far the Delavergne machine resembled the Linde, and how far it differed, and if he could state the amount of fuel it consumed on a long voyage. He did not think there could be any question about compressed-air machines, but with regard to the two different systems of using ammonia it would be very useful to have further information.

Colonel CUNNINGHAM said they ought to compliment the reader of the paper, as a foreigner, on the admirable way in which he had rendered a very difficult subject perfectly clear, partly by his ingenious comparison of the work to be done with the more familiar question of lifting water, and partly by his very simple geometrical diagrams, by which he had made the thermo-dynamic question tolerably plain. With regard to economic efficiency, he supposed that referred to operations on a large scale, but there was also the question of convenience in use. In India ice was of much greater importance as regarded personal comfort than in England, and domestic machines were there very valuable. He did not think compression machines would answer for such purposes, but the ammonia absorption machine, if not very economical theoretically, was sufficiently so practically to be very useful. The introduction of these machines into India had almost destroyed the industry of producing ice naturally. In certain parts of the plains there were real frosts in winter, and even where there were scarcely any frosts at all it was possible, by exposing water in very shallow vessels at night, to produce small thin sheets of ice, which was collected every night for several weeks, and stored against the

hot weather. Thousands of men were formerly employed in this industry, but it had now almost disappeared. In the larger stations the more economical machines were used, and ice was produced for sale; but at smaller stations they had to depend on domestic machines, which might not be so economical. The natives were much surprised to find that ice could be produced by burning coal, but they tried to explain the process themselves by the analogy of a mustard plaster reducing fever, or the drinking of hot liquids producing ultimately a sensation of coolness. They were already familiar with the storage of ice in blankets, which they called keeping it warm: so that they were partly prepared for the phenomenon of producing cold by the application of heat.

Mr. E. HESKETH said the author of the paper had certainly added a very important contribution to the somewhat scanty literature on the subject of refrigerators, but he wished he had reconsidered his position before again committing himself to the statements he had made on the subject of carbonic acid. It was stated, and appeared by the diagrams that the efficiency of carbonic acid was practically nil, when the cooling water was at 88°F , but that was distinctly not the case, as was shown by the fact that there were at present over forty carbonic acid machines working constantly through the tropics, where the water was often higher than 88° , and they were working perfectly satisfactorily. He assumed the statements made with regard to carbonic acid were based on theoretical considerations and experiment, but they all knew how difficult it was to experiment with such matters as liquid carbonic acid or ammonia, and he could only conclude that an error had crept in somewhere. It had been suggested that such machines, when the water was at 88° or over, worked in the same way as an air-machine, that the carbonic acid did not liquify, but that some sort of action took place, similar to that shown on the diagram. The fact, however, that these machines were working through the tropics without any expansion cylinders whatever, disposed of that suggestion, and showed that a similar action took place above 88° as below. He had seen many machines at work when the water was at 100° , and still acting efficiently. One important point which had not been touched upon was the safety of the material used, and, in this respect, ammonia could not be compared with carbonic acid. Every one knew how poisonous and offensive were the fumes of ammonia, but, with carbonic acid, the whole contents of a machine might be allowed to escape into a room without any fear of deleterious consequences. One effect of that was this, that in designing a machine, it was absolutely necessary that on both sides of the compressor there should be stop valves, so as to be able at any time to open the compressor and bottle up the chemical in the evaporator and condenser. If, by any chance, the attendant neglected

to open his delivery stop valve the consequences would be very serious, but in the case of a carbonic acid machine, a safety valve could be put in at that point, whilst with an ammonia machine such a remedy would be almost worse than the disease. There was no evidence to prove that carbonic acid machines were less efficient than ammonia machines, and even if it were so, the greater safety of using the former should have weight in deciding which was best to use.

Mr. MATHESON thought Mr. Hesketh had rather missed the point. Professor Linde did not say that carbonic acid could not be used when the cooling water was at 88° , but the economy of their use ceased, and they were no better than compressed air machines. It would be interesting to know whether the ammonia had been known to escape, because if amongst the hundreds of machines now in use no annoyance had arisen, the theoretical possibility had not much importance.

Colonel CUNNINGHAM said he had seen several ammonia machines at work where the temperature of the air was over 100° , and that of the water was probably over 88° . The offensive smell of ammonia was a great protection in the case of a domestic machine, as it gave you warning something was wrong. The danger was no doubt very great in the case of an explosion. He knew of one case in which a machine was blown up, belonging to a brother officer, and though he was not injured by any of the fragments, he died within a day or two from the effects of the ammonia.

Mr. HESKETH said he had known of several instances, but he had not the particulars with him.

Professor LINDE, in reply to Mr. Beaumont, said the progress of the different systems showed that practice was quite in accord with theory. The ammonia compression machine was by far the most used now, the reasons for the exceptions were so manifold that he could not attempt to go into them. He did not think Mr. Hesketh could have followed his explanation of Diagram 9. He explained that when the carbonic acid was coming from the condenser at 88° , the critical point, or higher, the whole amount of latent heat was consumed by the liquid heat in reducing the temperature of the liquid carbonic acid; the same amount of heat was taken away as was gained by evaporation. Mr. Hesketh suggested that his figures were not right, but he could only say that no other point in the whole theory of heat had been the subject of so much scientific research during the last few years as the state of carbonic acid at the critical point. It did not follow that a machine would cease to act at that temperature, because, as he had explained, it was possible to go far below the temperature T with the vapours; and then

to raise their temperature in the evaporator. When the carbonic acid entered the refrigerator it was in a state of saturated vapour; but if they were at a temperature of, say, zero, and the brine was maintained at a temperature of 23° F., then the temperature of the vapours could be raised in the refrigerator from zero to 23° , thus abstracting a certain quantity of heat from the brine, and so producing cold. That amount was represented by C D on the diagram. It was simply impossible to produce cold under such conditions with a smaller amount of work than the theoretically necessary amount represented by the whole area of the diagram. Cold air machines had brought cargoes of meat in very good condition through the tropics, and the carbonic acid was in a much better condition than air, because one pound of carbonic acid vapour took much more heat from the brine than a similar weight of air, its specific heat being much greater. It was a mistake to suppose that such a production of cold could not take place without an expansion cylinder. When air expanded from high pressure to low pressure it was necessary that it should do work on a piston, otherwise its temperature would not be diminished. If the air expands without doing work on a piston, then work is done on the air to give it a high velocity, which work might be termed living power. When it came to rest in the room, that living power was again returned in heat. In the case of carbonic acid, when it flowed from the condenser to the refrigerator, the work was not done outside, as in the case of the cold air machine, but internally; as the volume grew there were enormous internal forces at work, and the equivalent of this work replaces the outside work in the cold air machine. There was only one way of definitely settling such questions and that was by public experiment. In Munich there was a large testing station to which manufacturers were invited to send their machines for trial by a commission consisting of the highest authorities in Germany, Professor Zeuner being president. The tests were made in the presence of the commissioners and of the competitors so that the results were perfectly trustworthy. The safety of different systems must be judged by experience and the way to test them would be to take the number of machines made on each system and multiply them by the time they had been in work, and then ascertain how many accidents had occurred in each. In that way a fair comparison could be made. The result would show that carbonic acid was much more dangerous than ammonia, the reason probably being that the working pressure was from six to eight times larger. He knew of at least three accidents with carbonic acid machines; one occurred at Bar le Duc, where the attendant was killed by the explosion of the cylinder; one at Guinness's, in Dublin, where no personal injury was sustained; and one in a vessel at Buenos Ayres, where a carbonic acid bottle exploded, when it was being used to charge the machine, and two persons were killed. There were probably 40 times as many ammonia machines

at work as there were of carbonic acid, and they had been working at least three times as long, so that there ought to be 120 times as many accidents in order to show that they were equally dangerous; but he did not believe it would be possible to find even 40 or 50 such accidents.

The vote of thanks was then put to the meeting and carried unanimously.

Miscellaneous.

SEWERAGE OF THE WORLD'S COLUMBIAN EXPOSITION.

The site of the late World's Columbian Exposition at Jackson-park, Chicago, covers rather more than 600 acres. This site is very flat, varying in elevation from five to eleven feet above Lake Michigan, and sub-soil water is met with a few feet below the surface of the ground. In order to obtain, at a reasonable cost, gradients that would ensure the sewers being self-cleansing, the Shone hydro-pneumatic system was adopted.

The site was divided into twenty-six drainage districts, and in each a chamber was built underneath the surface of the ground or floor of building, as the case might be. In each chamber two Shone automatic pneumatic ejectors were placed, at such a depth that the sewers converging to an ejector chamber could be laid at sharp gradients. The motive power to operate these ejectors is compressed air; this was produced by air-compressors erected in the machinery-hall, from whence it was piped to each of the twenty-six ejector chambers, the total length of air-piping being five miles.

A system of discharge-pipes led from the ejector chambers to the sewage purification works at the southern boundary of the grounds. The sewage, upon delivery at the purification works, was treated chemically, the effluent was run off into Lake Michigan, whilst the solid precipitated matter was pressed, and then burnt in a furnace.

The lift from the ejector chambers to the top of the purification tanks was a little over 100 feet, requiring an air pressure of 50 lbs. per square inch at the ejectors.

The amount of sewage discharged by the ejectors varied with the attendance; on the days of greatest attendance 200,000 gallons per hour were discharged.

This large plant was thrown into operation at once, there being no previous opportunity of getting it into working order, and the whole apparatus started and operated for the occasion without a hitch, and at no time during the Fair was any portion

shut off from service through failure in the ejectors or compressed-air pipes; the few slight accidents that occurred being stoppages in the sewers themselves, through garments and other foreign material being passed into them.

In the report of Mr. MacHarg, chief engineer of the sewerage department, recently submitted to the Director of Works, he states, regarding the Shone system, "I consider it the most satisfactory apparatus which we could have used."

BRADFORD CORPORATION
ELECTRICITY SUPPLY.

Mr. James N. Shoolbred, B.A., Mem.Inst.C.E. has communicated the following Tables in reference to the discussion on Prof. Robinson's paper on "The St. Pancras Electric Lighting Installation" (see *ante*, p. 246), and in continuation of the information in his own paper on "The Bradford Corporation Electricity Supply," read May 4, 1892 (see *Journal*, vol. xl., p. 630) :—

HALF-YEARLY REVENUE ACCOUNT.

Working expenses.	1890.		1891.		1892.		1893.	
	June 30.	Dec. 31.	June 30.	Dec. 31.	June 30.	Dec. 31.	June 30.	Dec. 31.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Salaries and Wages.....	367 16 8	410 17 10	418 14 3	506 15 4	639 15 10	$\left\{ \begin{smallmatrix} 605 & 9 & 11 \\ 391 & 8 & 8 \end{smallmatrix} \right\}$	$\left\{ \begin{smallmatrix} 970 & 4 & 0 \\ 1,136 & 4 & 9 \end{smallmatrix} \right\}$	
Coal	246 17 11	247 0 6	292 18 6	342 7 0	334 2 0	375 16 6	486 0 1	845 0 3
Water	33 16 4	34 0 0	34 15 6	36 19 0	38 12 0	57 7 8	62 4 8	66 9 9
Repairs & miscellaneous	100 11 6	204 13 3	272 7 9	431 1 8	297 8 5	532 4 2	406 10 7	335 7 6
Rent of Land	83 18 1	83 18 1	83 18 1	83 18 1	83 18 1	83 18 1	83 18 1	83 18 1
Rates and Taxes	46 0 0	104 6 6	67 1 8	69 11 6	112 4 9	101 2 1	133 7 11	145 16 3
Bank Interest & Com- missions	19 1 4	89 14 9	95 9 7	120 7 5	108 2 11	104 1 6	111 1 5	139 11 4
Total Working Expenses	£898 1 10	1,174 10 11	1,261 5 4	1,591 0 0	1,614 4 0	2,311 8 7	2,253 6 9	2,752 7 5
Balance.....	- 39 7 0	377 18 10	832 8 2	2,001 1 0	1,601 12 11	2,386 14 11	2,294 1 6	2,882 7 3
Total gross Receipts ...	£858 14 10	1,552 9 9	2,093 13 6	3,592 1 0	3,215 16 11	4,698 3 6	4,547 8 3	5,634 14 8
Units sold	39,113	68,794	85,103	154,258	141,622	223,789	207,650	272,964

INTEREST AND SINKING FUND ACCOUNT.

Payments.	1889.	1890.		1891.		1892.		1893.	
	Dec. 31.	June 30.	Dec. 31.	June 30.	Dec. 31.	June 30.	Dec. 31.	June 30.	Dec. 31.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Interest on Loans ...	467 7 5	360 9 11	360 14 0	469 16 10	545 0 6	636 18 5	719 11 3	771 11 8	785 17 5
Sinking Fund.....	421 13 4	332 10 0	332 10 0	392 16 8	392 16 8	577 7 4	577 7 4	827 19 0	827 19 0
	£889 0 9	692 19 11	693 4 0	862 13 6	937 17 2	1,214 5 9	1,296 18 7	1,599 10 8	1,613 16 5

PROFIT AND LOSS ACCOUNT.

	£ s. d.		£ s. d.
1889. Dec. 31.—To debit of Revenue	1,079 8 5		
1890. { June 30.—To loss on half-year	732 6 11		
{ Dec. 31.—Ditto ditto	315 6 0		
1891. June 30.—Ditto ditto	30 5 4		
By Balance	290 11 7½		
	£2,447 18 3½		
1891. " Dec. 31.—By profit on half-year	971 4 10		
1892. { June 30.—Ditto ditto	387 7 2		
{ Dec. 31.—Ditto ditto	1,089 6 3½		
	£2,447 18 3½		
1893. By Balance from 1892	290 11 7½		
{ June 30.—By profit on half-year	625 16 10½		
" { Dec. 31.—Ditto ditto	1,179 1 0		

CAPITAL EXPENDITURE ACCOUNT.

1889. to Dec. 31.		1890. to June 30.		1890. to Dec. 31.		1891. to June 30.		1891. to Dec. 31.		1892. to June 30.		1892. to Dec. 31.		1893. to June 30.		1893. to Dec. 31.	
£	s. d.	£	s. d.	£	s. d.	£	s. d.	£	s. d.	£	s. d.	£	s. d.	£	s. d.	£	s. d.
18,456	2 4	25,223	19 11	27,209	4 8	35,370	7 11	40,224	19 10	45,136	8 6	48,568	12 11	52,309	2 4	56,591	1 2

RATES PER UNIT.

	1890.	1891.	1892.	1893.
	s. d.	s. d.	s. d.	s. d.
Price charged per unit sold	0 5	0 6	0 5	0 5
Working cost „ „	0 4'6	0 2'8	0 2'6	0 2'5
Capital expended „ „	3 5	3 4	2 8	2 4

In an analysis (given by Mr. Crompton in *Lightning*, Jan. 4, 1894) of the cost of supplying electricity in England, in 1892, he finds that, at twelve central working stations, with "continuous" currents, the average capital expended per unit sold was 5s. 1½d.; while at nine stations, working with "alternating" currents, the average was 8s. 8d.

Correspondence.

TELEGRAPHIC COMMUNICATION
BETWEEN ENGLAND AND INDIA.

MR. CHARLES BRIGHT, Assoc.M.Inst.C.E., M.I.E.E., writes:—With reference to my remarks on Mr. E. O. Walker's recent paper, published in the *Journal* (see *ante*, p. 232), it should be further stated that the particular sense in which the first Persian Gulf cable may be said to be the first submarine cable submitted to a proper system of electrical testing during manufacture, is in virtue of the fact that it was the first time that the core was tested, when submerged in water, in separate lengths of about three nautical miles. As soon as the copper conductor had been made in this length it was covered with gutta-percha (as now) in three separate coats, adhered together and to the conductor by means of Chatterton's compound (also applied previously to the centre wire of a stranded conductor, to obviate any tendency of the water creeping, as from an unsealed or damaged buoyed end, along the conductor, between the interstices of its component wires with fatal results), after which the coil of completed core was immersed in a tank of water, maintained at a certain standard temperature, and so as to give the water every chance of percolating at any weak spot to the conductor. For all gutta-percha cores Chatterton's compound has proved a most valuable patent. There is only one case in which another compound was used in its place, the defect

being most disastrous to all concerned, owing to the presence of coal tar therein, the gas of which blew holes in the gutta-percha when under the pressure of the sea, or else it was due to evaporation of the naphthaline, which was used as a solvent. It was in this way that Messrs. Bright and Clark instituted the first crucial test to a submarine cable under manufacture, when in the core stage, by being kept in water. A further object in this method was to ensure a certain temperature for the core during the test, so as to eliminate the item of temperature in its effect on the electrical resistance, both of the conductor and the insulator, by testing all the coils at the same temperature chosen as a standard, by means of which the electrical values of any portion of the cable, at any other temperature subsequently, could be compared with its original values as core at the standard temperature, by applying to the observed values the co-efficient for the reduction of the resistance of the material to the standard temperature. This co-efficient was, in the case of gutta-percha, first ascertained in connection with this cable by Messrs. Bright and Clark, from the series of experiments made by them on gutta-percha at various temperatures. A little later, Mr. T. P. Bruce Warren determined similarly the co-efficient of variation in the electrical resistance of vulcanised india-rubber (as then made by Messrs. Hooper), by measuring its resistance at various temperatures. The system of core testing, described as being, in the first instance, adopted during the construction of the Persian Gulf cable of 1863, met, moreover, the purposes of a specification, in which it is usual to stipulate for a certain conductor and di-electric resistance, within stated limits, after a certain period of immersion (at least 24 hours) in water at 75° Fahr., a convenient mean standard temperature. The same system is now adopted at all cable works, although the standard temperature and period of immersion is, in some cases, different. At certain works (notably at the Telegraph Construction and Maintenance Company's Gutta-percha Works) the core is tested at a lower temperature of 40° or 50° Fahr., with the object of more certainly being able to detect any small incipient faults. This is based on the principle that any change (in the form of weakness) in an insulating material shows itself more readily in an electrical test when the material is in a condition elsewhere such as offers a high electrical resistance, as would tend to be the case at a low temperature. Moreover, if a lower temperature be taken

as a standard, being more nearly what the core itself is most likely to experience after submergence, under any considerable depth at the bottom of the sea, the error necessarily occurring in any reductions of the electrical values to that (standard) temperature (owing to the fact of a general co-efficient, not being absolutely applicable to any particular batch of gutta-percha) is considerably lessened. On the other hand, the higher the temperature, the greater the general strain put on the electrical resistance value of the core, besides being a severer test mechanically, though a minute fault may not be actually as easy to discover. It must be remembered, also, that in tropical climes, at shore ends, *i.e.*, up to the hut, the cable often has, ultimately, to experience exceedingly high temperatures, when, for instance, unavoidably running under a long stretch of dry sand. Hence, at the Silvertown works the temperature of 75° Fahr. is adhered to as a standard for core testing.

General Notes.

CHICAGO MEDAL.—Many inquiries have been made as to the design of the Chicago medal, and an application on the subject was addressed by the Secretary of the Royal Commission to the Exhibition authorities. He has now been informed that the design of the medal has not yet been fully and finally approved. It appears that the obverse is already finished, but the reverse is undergoing modification. It is expected that the design will soon be completed and approved, and it is promised that as soon as this is done, a copy of the medal shall be sent to England.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

MARCH 14.—“The Fountain Air Brush.” By CHARLES L. BURDICK. FRANCIS COBB, Treasurer of the Society, will preside.

Papers for which dates have not yet been fixed:—

“Reproduction of Colour by Photography.” By CAPTAIN W. DE W. ABNEY, C.B., F.R.S.

“London Coal Gas and its Enrichment.” By PROF. VIVIAN LEWES.

“Experiments in Aeronautics.” By HIRAM S. MAXIM.

“Automatic Gem and Gold Separator.” By WILLIAM S. LOCKHART.

“Application of Electricity to the Disinfection of Sewage.” By MONS. HERMITE.

“Design Applied to Carpets.” By ALEXANDER MILLAR.”

INDIAN SECTION.

The meetings of April 26, and May 24, will be held at the Society of Arts; the meeting on March 19 will be held at the Imperial Institute.

MONDAY, MARCH 19, at 8.30 p.m.—“Indian Railway Extension: its Relation to the Trade of India and of the United Kingdom.” By JOSEPH WALTON. SIR JAMES KITSON, Bart., M.P., will preside.

THURSDAY, APRIL 26, at 4.30 p.m.—“Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh.” By SIR AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieutenant-Governor of the North-West Provinces and Oudh.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on Tuesdays, at Eight o'clock:—

APRIL 17.—“Tasmania and the forthcoming Hobart International Exhibition, 1894-95.” By J. F. ECHLIN.

MAY 1.—“Paraguay.” By A. F. BAILLIE.

MAY 29.—“Education in Victoria.” By Prof. C. H. PEARSON, M.A., LL.D.

APPLIED ART SECTION.

Tuesday Evenings, at Eight o'clock:—

APRIL 10.—“The Evolution of Decorative Art.” By HENRY BALFOUR, M.A. SIR GEORGE BIRDWOOD, M.D., K.C.I.E., C.S.I., will preside.

MAY 8.—“Pewter.” By J. STARKIE GARDNER. PROF. W. C. ROBERTS-AUSTEN, C.B., F.R.S., will preside.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

HUGH STANNUS, F.R.I.B.A., “The Decorative Treatment of Traditional Foliage.” Four Lectures.

LECTURE IV.—MARCH 12.—*Applications*: The Stalk-leaf—Sheath-leaf—Cup-leaf—Rosette—Korinthian leaf—Moulding enrichment.—*Varieties*: The Canon not closed—Individual treatments—Wealth of suggestion in Nature—Further developments.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 12.—SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Hugh Stannus, “The Decorative Treatment of Artificial Foliage.” (Lecture IV.)

Scottish Society of Arts, 117, George-street, Edinburgh, 8 p.m. 1. Report on Mr. Pearson's paper on “Patent Drilling Apparatus for Gas and Water Mains.” 2. Report on Mr. Laing's paper on “Oil-gas.” 3. Mr. W. B. Blaikie, “A New Ambulance Wagon with Pneumatic Tyres.” 4. Dr. B. Orphoot, A New, Simple, and Inexpensive Rubber Appliance for Hermetically Closing Bottles, Jars, Tins, &c.”

Imperial Institute, South Kensington, S.W., 8½ p.m.
Lieut.-Col. Groves, "Regiments of the British Army which have been Raised in India or for Colonial Service (1661—1893)."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mr. W. H. Cozens-Hardy, "Montenegro and its Border Lands."

British Architects, 9, Conduit-street, W., 8 p.m.
Special General Meeting:—1. To elect Gold Medallist for the Current Year. 2. Discussion on "London Streets and Buildings Bill."

TUESDAY, MARCH 13...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.)
Adjourned discussion on Mr. Barr Robertson's paper, "The Indian Currency."

Royal Institution, Albemarle-street, W., 3 p.m.
Prof. Charles Stewart, "Locomotion and Fixation in Plants and Animals."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on:—1. Messrs. J. H. Greathead and Francis Fox's papers, "The Liverpool Overhead Railway." 2. Mr. Thomas Parker's paper, "The Electrical Equipment of the Liverpool Overhead Railway." 3. Mr. Ernest Collins, "The Prevention and Detection of Waste of Water." 4. Reception by the President and Council.

Sanitary Institute, 74A, Margaret-street, W., 8 p.m.
Dr. J. F. J. Sykes, "Objects and Methods of Inspection."

Photographic, 50, Great Russell-street, W.C., 8 p.m.
Anthropological, 3, Hanover-square, W., 8½ p.m.
1. Prof. B. H. Chamberlain, "Two Funeral Urns from Loo Choo." 2. Mr. C. J. Longman, "The Bows of the Ancient Assyrians and Egyptians." 3. Mr. O. A. Shrubsole, "Flint Implements of a primitive type from old (pre-glacial) hill gravels in Berkshire."

Imperial Institute, South Kensington, S.W., 8½ p.m.
Hon. John Walpole, "Tasmania."

Colonial Institute, Whitehall-rooms, Whitehall-place, S.W., 8 p.m.

Asiatic, 22, Albemarle-street, W., 3 p.m.

WEDNESDAY, MARCH 14...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Charles L. Burdick, "The Fountain Air Brush."

Naval Architects (at the HOUSE OF THE SOCIETY OF ARTS), Annual Meeting, 12 noon. 1. Address by the Chairman, Admiral the Right Hon. Sir John Dalrymple-Hay. 2. Presentation of Gold Medals to Mr. George A. Calvert and to Herr Otto Schlick. 3. Mr. W. H. White, "The Qualities and Performances of Recent First-class Battle-ships." 4. Mons. Emile Bertin, "The Amplitude of Rolling on Non-synchronous Waves." 5. Prof. A. G. Greenhill, (i.) "The Stresses on a Ship due to Rolling," (ii.) "Leclerc's Theorem."

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.
Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

Entomological, 11, Chandos-street, W., 7 p.m. 1. Mr. Frederic Merrifield, "Temperature Experiments, in 1893, on Species of the genus *Vanessa* and other Lepidoptera." 2. Mr. Wm. Hampton Patton, "The classification of Hymenopterous Insects." 3. Rev. Canon Fowler, "Some New Species of Membracidae."

THURSDAY, MARCH 15.—Naval Architects (at the HOUSE OF THE SOCIETY OF ARTS), 12 noon. 1. Charles E. Ellis, "Recent Experiments in Armour." 2. Capt. W. H. Jaques, "Submarine Artillery." 3. Professor V. B. Lewes, "Leaves from a Laboratory Note Book: (a.) Some Points Affecting the Combustion of Fuel in Marine Boilers; (b.) The Spontaneous

Heating of Coal." 7 p.m. 1. Mr. J. I. Thornycroft, "The Circulation of Water in Thornycroft Water Tube Boilers." 2. Mr. J. T. Milton, "Water Tube Boilers." 3. Mr. James Howden, "The Comparative Merits of the Cylindrical and Water Tube Boilers for Ocean Steamships."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. C. B. Clarke, "Certain Authentic Cyperaceæ of Linnæus." 2. Mr. George Brebner, "The Development of the Mucilage Canals of the Marattiaceæ."

Chemical, Burlington-house, W., 8 p.m. Professor Dunstan and Dr. A. Bossi, "The Action of Hydroxylamine on Formic Aldehyde."

Society for the Encouragement of Fine Arts, 8 p.m.
Conversazione at the Royal Institution of Painters in Water Colours, Piccadilly.

Parkes Museum of Hygiene, 74A, Margaret-street, W., 5 p.m.

Royal Institution, Albemarle-street, W., 3 p.m.
Professor Max Müller, "The Vendânta Philosophy."

Historical, 20, Hanover-square, W., 8½ p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

Imperial Institute, South Kensington, S.W., 8½ p.m.
Mr. W. D. Severn, "The Rabbit Plague in Australia."

FRIDAY, MARCH 16...Naval Architects (at the HOUSE OF THE SOCIETY OF ARTS), 12 noon. 1. Mr. Otto Schlick, "Further Investigations on the Vibration of Steamers." 2. Mr. T. C. Read and Mr. G. Stanbury, "The Relation between Stress and Strain in the Structure of Vessels." 3. Mr. C. E. Stromeyer, "Steam Pressure Losses in Marine Engines." 7 p.m. 1. Mr. D. Croll, "Experiments with Triple Expansion Engines at Reduced Pressures." 2. Mr. David Joy, "Fluid Pressure Reversing Gear." United Service Institution, Whitehall-yard, 3 p.m.
Lieut.-Colonel H. A. Sawyer, "The Firing Line, and How to keep it Organically Sub-divided to the Last."

Royal Institution, Albemarle-street, W., 8 p.m.
Weekly Meeting, 9 p.m. Lord Rayleigh, "The Scientific Work of Tyndall."

Civil Engineers, 25, Great George-street, S.W., 7½ p.m. (Students' Meeting.) Messrs. S. Henry Barraclough and Lionel S. Marks, "Coal Storage in the United States."

Queckett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Sanitary Institute, 74A, Margaret-street, W., 8 p.m.
Dr. A. Newsholme, "Nature of Nuisances, including Nuisances the Abatement of which is Difficult."

SATURDAY, MARCH 17...North-East Coast Institute of Engineers and Shipbuilders, The Athenæum, West Hartlepool, 8 p.m.

Royal Institution, Albemarle-street, W., 3 p.m.
Lord Rayleigh, "Light: with special reference to the Optical Discoveries of Newton."

CORRECTION.—P. 307, col. 2, line 9, omit "or Kansas." Dr. Alexander MacFarlane is professor at the University of Texas. The experiments were carried out by General Dyrenforth, and the last bombardment was at San Antonio, Texas, in November, 1892.

Journal of the Society of Arts.

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FRIDAY, MARCH 16, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

On Monday evening, 12th inst., Mr. HUGH STANNUS, F.R.I.B.A., delivered the fourth and last lecture of his course on "The Decorative Treatment of Artificial Foliage."

The CHAIRMAN (Mr. Francis Cobb) proposed a vote of thanks to the lecturer for his valuable course of lectures, which was carried unanimously.

The lectures will be printed in the *Journal* during the summer recess.

THE ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1894 early in May next, and they, therefore, invite members of the Society to forward to the Secretary, on or before the 14th of April, the name of such men of high distinction as they may think worthy of this honour. The medal was struck to reward "distinguished merit for promoting Arts, Manufactures, or Commerce," and has been awarded as follows in previous years:—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S.

In 1865, to his Imperial Majesty, Napoleon III.

In 1866, to Michael Faraday, D.C.L., F.R.S.

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S.

In 1868, to Mr. (afterwards Sir) Joseph Whitworth, LL.D., F.R.S.

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c.

In 1870, to Vicomte Ferdinand de Lesseps, Member of the Institute of France, Hon. G.C.S.I.

In 1871, to Mr. (afterwards Sir) Henry Cole, K.C.B.

In 1872, to Mr. (now Sir) Henry Bessemer, F.R.S.

In 1873, to Michel Eugène Chevreul, For. Memb. R.S., Member of the Institute of France.

In 1874, to Mr. (afterwards Sir) C. W. Siemens, D.C.L., F.R.S.

In 1875, to Michel Chevalier.

In 1876, to Sir George B. Airy, K.C.B., F.R.S., late Astronomer Royal.

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., Member of the Institute of France.

In 1878, to Sir Wm. G. Armstrong (now Lord Armstrong), C.B., D.C.L., F.R.S.

In 1879, to Sir William Thomson (now Lord Kelvin), LL.D., D.C.L., F.R.S.

In 1880, to James Prescott Joule, LL.D., D.C.L., F.R.S.

In 1881, to August Wilhelm Hofmann, M.D., LL.D., F.R.S.

In 1882, to Louis Pasteur, Member of the Institute of France, For. Memb. R.S.

In 1883, to Sir Joseph Dalton Hooker, K.C.S.I., C.B., M.D., D.C.L., LL.D., F.R.S.

In 1884, to Captain James Buchanan Eads.

In 1885, to Mr. (now Sir) Henry Doulton.

In 1886, to Samuel Cunliffe Lister (now Lord Masham).

In 1887, to HER MAJESTY THE QUEEN.

In 1888, to Professor Hermann Louis Helmholtz, For. Memb. R.S.

In 1889, to John Percy, LL.D., F.R.S.

In 1890, to William Henry Perkin, F.R.S.

In 1891, to Sir Frederick Abel, K.C.B., D.C.L., D.Sc., F.R.S.

In 1892, to Thomas Alva Edison.

In 1893, to Sir John Bennet Lawes, Bart., F.R.S., and Sir Henry Gilbert, Ph.D., F.R.S.

A full list of the services for which the medals were awarded was given in the last number of the *Journal*.

Proceedings of the Society.

FOREIGN & COLONIAL SECTION.

Tuesday, March 6, 1894; Capt. V. LOVETT CAMERON, R.N., C.B., in the chair.

The CHAIRMAN, in introducing M. Foa, referred to the celebration, on the preceding evening, at the Royal Geographical Society, of the 500th anniversary of the birth of Prince Henry, the navigator. A great deal was there said about his achievements, but if he had lived now the Prince would probably have been rather a member of the Society of Arts, Manufactures and Commerce than of the Royal Geographical Society, for all his great labours in the interest of the science of geography were really means to an end, viz., the opening out to the commerce of Europe, of Africa and India. It was, therefore, very appropriate to

the morrow of this celebration, that they should now hear about a part of Africa, which, if not immediately opened up during the lifetime of Prince Henry, was practically opened up by him, because it was during the voyage of Vasco de Gama, who was trained in the school of Prince Henry, that the Zambesi was discovered.

The paper read was—

TRAVELS IN THE BASIN OF THE ZAMBESI.

BY EDOUARD FOA, F.R.G.S.

In the beginning of the year 1891 I was sent out by the Central African and Zontpausberg Exploration Company, Limited, for the purpose of exploring the countries neighbouring the Zambesi, and giving a full report of my journey as to the prospects of trade, and the future of the country, as well as from a scientific point of view.

I landed at Cape Town and travelled through the Orange Free State, the Transvaal, Natal, &c., but as I have only a short time to give an account of the journey, I will only speak now of the most interesting part of my discoveries, that is to say, the new countries situated north of the Zambesi and west of the Shire. These two rivers will play a great part in the future development of this part of Africa; first, because they are easy roads to the lake regions, and also because there are ready means of transport for passengers, and for the products of trade and industry. I will, therefore, commence by giving a short account of the second part of my journey,

Quilimane is a town which offers very fine views. When one arrives from the sea one is charmed by the sight of nice clean white-washed houses, surrounded by gardens. In the far distance are immense forests of cocoa nut. From Quilimane to Vicenti there are two ways of communication; the first is the Quaqua, already known and described by several travellers, the second is the Chindi mouth, which is proportionately new and more interesting than the dirty little river called the Quaqua.

From Quilimane we proceed to the Chindi mouth of the Zambesi in a little steamer belonging either to the Union or the Castle line. The Chindi is one of the seven mouths of the Zambesi, and was first found to be so by a British traveller, Mr. D. J. Rankin, and it is only a few years since steamers and gunboats have taken to stopping there. Although it is believed that in the future the Chindi

will take the place of Quilimane, yet I think it has been over-rated. The depth on its bar is only 12½ feet at the highest tide, but the Quilimane mouth will always give passage to steamers having a minimum of 15 feet draught. This is of very great importance, because it prevents large ships going into the Chindi, and, consequently, its harbour cannot become of any importance. When we come out of the Chindi mouth we reach the Zambesi, which is very broad at that point, and I estimate the distance between one bank and the other as at least three miles. One can hardly distinguish the heavy timber and forests on the other side, which look like a very low black line.

The average current of the Lower Zambesi is about five to seven knots, according to the time of the year; the depth is not considerable, and does not exceed an average of 2 ft. 6 in. The course of the river is continually interrupted by islands, all placed in the middle of its channel. The steamers have constantly to take a winding course, and this is one of the reasons for the large amount of time required to cover small distances. The lower Zambesi is one of the richest parts of the country, as far as the cultivation goes. There are many villages on the banks, and its prazos—concessions given by the Government to private firms—are the only ones which pay easily.

If we go up the river a little further, we meet with the Shire delta. The Shire mouth comes from a north-west direction into the Zambesi, and is made difficult of access by the quantity of islands which hide it from the sight of the traveller.

The origin of the Shire is, as you know, the outlet of the waters of Lake Nyassa, which pass *viâ* the Zambesi into the sea. Its length does not exceed 450 miles; its breadth 200 yards. Its depth is, proportionately, more than that of the Zambesi, and the populations on its banks are very numerous. The best months for navigation on the Shire and Zambesi are, without doubt, from February to the end of June. East of the Shire a British colony, established two or three years ago, is going ahead rapidly. One of its principal wealths is coffee-planting, which has been up to the present successful.

I am now speaking of Nyassaland; Blantyre, a missionary station, is of most importance, but Kalunga and Chiromo are becoming towns instead of native villages.

About the middle of the course of the Shire we find the Murchison cataracts, produced by

the extension of a branch of the Manganja Hills towards Blantyre. More to the east and west, civilisation has not yet penetrated, and I will describe further on the countries I have passed through.

After this rapid sketch of the Shire, we continue our Zambesi journey, and reach Sena, an old Portuguese township, once of considerable prosperity, but now completely ruined. We pass the Lupata gorges, which offer to the traveller one of the finest bits of scenery on the whole river. A very strange phenomenon can be observed in these gorges. The Zambesi, being about 1,800 yards broad above the Lupata and 2,300 below the gorges, the river is suddenly contracted during its passage to about 200 yards, without increasing in depth. The current is only a few knots faster. My first impression was, that there could be, either to the north or south, a branch of the main river, but I soon discovered that there was none.

Above the Lupata we come to Bonga, a place of historical celebrity. Bonga was once a very powerful chief—a half-caste, of Indo-Portuguese extraction—who held the whole of the Zambesi under his influence, and for years the Portuguese could not pass without paying tribute or obtaining his permission. To-day, Bonga has disappeared, although some of his children are living, but powerless.

A little above Bonga we come to Tete, which is about 275 miles from the sea. Tete, like Sena, has been a very great township in old times. The figures of its trade were considerable; gold, ivory, and also ground nuts, india-rubber and wax were exported from Tete 50 years ago in enormous quantities; to-day, the town has almost completely disappeared from the list of East African markets. The fault is not owing to the products of the country being scarce, but to the carelessness of the people, who have had the country for the last 300 years; to their defective way of trading; to their ill-treatment of the natives; and also a little to the want of protection and help from the local Government.

The topographical situation of Tete is in the old bed of the Zambesi. The river seems to have retired 1000 years ago, and left lines of ridges and valleys, chiefly composed of sandstone, covered with grass and indigo. It is here the town has been built; the top of the ridges are covered with houses, and the spaces between are streets.

Above Tete we find the Kebrabasa falls, the first cataracts on the Zambesi since we

left the sea, although we could believe that Nature wanted to put the first rapids at the Lupata gorges and afterwards changed her mind. These falls extend over about four miles: they begin a few hundred yards from Massinnangwe, they are principally composed of a few rapids and waterfalls, which do not exceed in the dry season more than 6 or 7 feet, and which are nearly covered during the flood. I believe that human industry will one day improve the Kebrabasa region, either by blasting away the rocks, digging a side channel, or building a railway along its banks so as to join the Upper and Lower Zambesi.

Above the Kebrabasa falls the Zambesi seems more navigable and proportionately deeper than in its lower waters. That is to say, that the sand is scarcer, that the islands are less numerous, and the river seems clearer, I mean less covered with vegetation.

The Chicó country occupies the right bank of the Upper Zambesi. The old Portuguese had great hopes on that country, and described it as containing numbers of gold and silver mines.

My exploration of the Zambesi, made both at low and high waters and at all times of the year, stopped at Sebastiao Moraes, about 450 miles from the Chindi mouth. There, our expedition left the Zambesi and ventured to the north region, where, in many places, we were the first Europeans to visit the country.

I will give here a brief description of the several countries situated between the north of the Zambesi and the south-west of Lake Nyassa.

Quite in the west, north of the Kebrabasa falls, we find a very high plateau of mountainous country, divided into several kingdoms or chieftainships, of which the principal are the Undi country, called by the old Portuguese the Occidental Maravi, the Chiuta country, lying to the south of the former, the Missalé and Mano countries, to the north of Chiuta, the Foulankungo to the north, and Makanga to the south, the Muanamarungo, the South Angoni, and, finally, Mikorongo and Manganja, lying near the Shire river.

These countries have the greatest importance, not only because we have been the first Europeans to visit the greater part of them, but also because they are very rich, and can give to trade and industry, nearly immediate results.

The minerals which are found in the countries are of several kinds. All the rivers

running into the Zambesi, most of which follow the same direction, N. to S., we find alluvial gold in more or less quantities. A large bed of coal extends from the Tete region, taking a north-eastern direction up to the Kilimanjaro plateau, and keeps for the future a prosperous industry. We began to dig and extract coal in one of the favourable points for immediate use; that point is situated a few hundred yards from the Zambesi, and from one of its northern affluents called the Revugwe. Three or four galleries are already opened and working, and a few hundred yards of railway will take the coal to the Zambesi bank, ready for the use of the steamers, and to be taken down to the Chindi and East African seaports. This coal is recognised, and proved to be of good quality, and therefore we have great hopes of the success of the undertaking. Quite near to the coal, to the north of Tete and Chicoo, above the Kebrabrasa falls, we find another bed of pure copper quartz, pure malachite crystals, and also, in several places, hot sulphuric springs. Later on, the copper will become valuable when the means of communication will be cheaper, which is sure to happen.

A few traces of graphite indicates also the possibility of the existence of some lead; and that is corroborated by what I have told you about the silver mines, as one is scarcely found without the other.

The whole country through is covered with magnetic iron and pure iron ore. As to the vegetation, there are in the jungle many fibrous plants, a kind of wild aloes, and a small plant, called buazi, used by the natives to make fishing nets, and numerous kinds of barks, which are fit for the same purpose. The cocoa nut, though cultivated, gives fibres already known on the market.

We also find wild, gum copal, india-rubber in quantities in certain regions, and all along the Lower Zambesi heavy timber, such as ebony, redwood, ironwood, and other species, all fit for good cabinet work. Various oil seeds can also be found in great quantities in the bush.

The animal products to add to the above commodities are elephant and hippo ivory, antelope and buffalo horn, the skins of these animals, &c.

At present, although there is a great disposition in the country to adopt money as the medium of exchange, owing to the influence of the British and Portuguese, yet a great number of the natives use only goods for bartering. These goods consist of ordinary quality calico,

small-sized beads, brass wire, and a few kinds of prints.

Native labour can be obtained in fair quantities, and, if treated with care, the people will willingly work for European colonists in a very satisfactory manner.

A considerable amount of trade can be carried out in the vegetable, mineral, and animal products which I have just described, and the nature of the soil, rich and fit for cultivating, will add another important branch to the industry of the country. Arabian coffee on the high ground, Liberian on the low cocoa, cinchona, indigo (also gathered wild), india-rubber, tobacco, opium, rice, maize, and millet, the latter for feeding the natives, can be cultivated with success. The price of land is not exorbitant, and considerable tracts of country can be had for a moderate sum.

I have already spoken of the success of the coffee cultivation in Blantyre, only commenced about ten years ago with a few acres, and which covers to-day more than 50,000 acres. Of course, all this extension in trade, cultivation, and other industries, would be very difficult without means of communication, but these means exist already, although many people are not aware of it.

At the end of 1892, partly on the reports made after my hydrographic exploration of the Zambesi, a steam navigation company was organised and established at the Chindi, under the name of the African International Flotilla and Transport Company, Limited. The title of the company by itself shows that its services are for all nationalities interested on the Zambesi and Shire rivers. The flotilla company has a fleet of three shallow-draft steamers, which will be increased shortly. They are actually overburdened with orders, and can hardly carry out half the work to be done. The sphere of operations of the flotilla company is limited to-day to the Lower Zambesi and Shire rivers, but in a very short time I hope it will have a transport service on the upper rivers, that is, above the Kebrabrasa and Murchison falls, and finally on Lakes Nyassa and Tanganyika.

I have tried to sketch as briefly as I could all the practical advantages of a country which is not yet known, and to which the attention of people wanting a use for their energy and capital has not yet been drawn.

I can add that the height of the country north of the Zambesi is sufficient to render the climate more healthy and regular than on the East Coast of Africa or the Zambesi Valley.

The altitude of Makanga and Mikorongo averages 1,000 to 1,200 feet above the sea-level, the temperature is moderate, compared to that of the sea coast, and I believe that Europeans could easily become acclimatised, in a few years, in this interesting part of Africa.

Looking at the country from an artistic point of view, we find it most lovely. The scenery changes continually, and the numerous mountains and hills destroy that monotony which is so noticeable in extensive plains.

I had, during my long journey, several interesting hunting adventures with the inhabitants of the forests. Frequently, during my walks in the bush, I have come across ill-tempered animals, but my good luck and my good rifle gave me the victory over them.

I have also considered the country from a scientific point of view, but I have no time to-night to give you here any technical details. I have made reports on the scientific results of my journeys, and already had the honour of receiving the gold medal of the Paris Geographical Society. To show you the work done, I will let you have a glance at two maps, the first representing the country as it was known in 1891, and the second as it is now known after my return.

A very small portion of the African continent remains to be discovered now-a-days, as civilisation has penetrated nearly everywhere. I have been travelling in Africa myself for about eleven years. Therefore, the discoveries become scarcer. I have been glad of the opportunity of giving you this brief description of a country really new, and full of hopes for the future—a country which promises to become one of the most important in the Dark Continent.

DISCUSSION.

Mr. D. J. RANKIN said he had had the pleasure of Mr. Foa's companionship in 1891 in the very country he had been speaking of, and he agreed with much that had been said, but he thought he had been a little bit hard on the Chindi. He was the first to paddle a canoe over the Chindi, but M. Foa seemed to be rather down upon it simply because there was only one fathom at low water spring tides, whereas in the Quilimane there was $2\frac{1}{2}$ fathoms, and therefore he said the Chindi would never be any good. He rather disagreed with that. No doubt there was a bar there, as there was at the mouth of nearly all the rivers in the world. No doubt a large vessel could go into the Quilimane river much better, but after getting a certain distance they had not only to pass through

the Portuguese Custom-house, but to put everything into lighters and to travel for five days in canoes, and then there was a certain distance where everything had to be carried over a swamp on natives' backs, so that the goods had to be split up into loads of about 40 lbs. and carried about six miles, before they reached the Zambesi. The result was that 66 per cent. never got to its destination. Now the Chindi communicated directly with the Zambesi, and 66 per cent. was saved, besides all the expense of discharging and reloading. The whole stuff could be loaded straight from the ocean steamer on to small river steamers belonging to the Flotilla Company, and so could be taken into the centre of Africa without trans-shipping again. That was what was going to revolutionise Africa. It was doing so now, for it commenced about four or five years since. It was very hard to earn a living now-a-days, and he should advise the young people of this country that there was no country where there were better opportunities of earning a living than in the Makonda country and Undi country. It was a healthy place, there was a great deal of gold there, and you were within one week of the sea coast. The Mashonaland and the Matabele country might be as good for gold, but the price of gold was not the gold itself in the ground, but what it cost to obtain it. Here you could run a steamer into the gold-fields, and there was plenty of coal close to the gold-fields and plenty of water. In Matabele land and Mashonaland there was gold probably, but how could it be worked? It was in the rock, and to take machinery there cost more than the gold was worth. Here there were no such difficulties, but all you had to do was to take your gold, to put it into cases, and put them on board.

The Rev. HORACE WALLER said it was his good fortune to make his first acquaintance with these countries in company with Dr. Livingstone and Bishop Mackenzie. It was a great pleasure to him to hear the reports of present day travellers, but he should like to introduce a few connecting links which seemed to be missing between the ancient history which he represented, and the geography of to-day. In the first place he did not think M. Foa had been (as Mr. Rankin, the discoverer of the Chindi had said) quite fair to the natural features of that part of the world. Briefly, you had a direct communication with the Zambesi by entering it at the Chindi, but if you went to the Quilimane river you passed up through a broad mouthed funnel until you came to a very attenuated stream called the Qua Qua, and then you had to get out and walk, and carry anything you wanted across to the Zambesi. Everyone must appreciate the superiority of a direct communication with the interior of a country as compared with entering an estuary, for that was really what the Quilimane was, which had no communication whatever with the Zambesi river. He should also be inclined to take off a knot or two from the current of

the Zambesi. He stayed there for a considerable time, and it was very necessary for Dr. Livingstone (who was then taking two steamers up the Shiré river) to be exactly acquainted with the rate of the stream. He recollected that they could hardly make it a current of four knots. With respect to his travels, M. Foa forgot that early in 1860 other travellers had passed over this country. Dr. Kirk and Mr. Rae, then exploring with Dr. Livingstone on his steamers, passed over to Tete from the cataracts of the Shiré, so that they must have gone very near across the map which had just been exhibited. Again, Mr. Montague Carr passed through the same country, and probably traversed exactly the path M. Foa had more recently described. He had been rather surprised to find two companies which were running steamers there utterly ignored, and it would be great injustice not to mention the fact that the African Lakes Steamer Company had not only vessels on Lake Nyassa, but had conveyed steamers across to Lake Tanganyika, and had for a number of years been carrying out all that enterprise which, no doubt, lay at the bottom of M. Foa's exertions in that country. There was another gentleman who had not been alluded to, who was very well known to Mr. Rankin, and who was at present anxiously developing the steam navigation on the Shiré, Zambesi, and Lake Nyassa, that was Mr. Scharer. He had not much acquaintance with him, but he had correspondence with many settlers at Lake Nyassa and Blantyre, and he knew that they were accustomed to place degrees of comparison opposite the names of these various companies. It would not, perhaps, be convenient at the present moment to say which was the positive, the comparative, or the superlative, in point of efficiency, but he would emphasise the fact that for a number of years the Glasgow or African Lakes Company had been running steamers throughout this river and lake system, and very probably anybody landing at the Chindi mouth would find one of their steamers there at the present moment. With regard to the colonisation of the country, he had not the advantage possessed by M. Foa of having been in the country between Tete and the south-west corner of Lake Nyassa, but he spent some years on the Shiré, and also near Blantyre, and had the great honour of planting the first coffee ever planted in the Shiré highlands: he thought it was suicidal to keep in the back ground the greatest drawback to colonisation there, and that was the question of health. Anyone who tried to make it out a very healthy country would probably find himself called to book in the course of time. At Blantyre there was everything studiously adopted which could lead to good health; there were very excellent houses, there were physicians there, and there was the highest state of morality upheld. The residents were mostly picked men, Scotch or English; cultivated, refined men from the Universities, and yet the result was they found it not a healthy country. Fever was present there, and especially to young men from

eighteen to twenty-four it laid a great strain on their constitution. He had lost so many friends in these parts that it would be traitorous not to paint the picture exactly as it was. On the other hand it was only right to say that there were men there, who had taken care of themselves—for that was essential—who had lived many years in the country and were doing well. The coffee plantations were magnificent, and there was no question that many were really making a great deal of money. Still the everlasting labour question was cropping up, as it did in all other parts of the world, and it was not going to be all smooth sailing in the future. The list of products of the country might really have been enlarged. There were all kinds of tropical produce, including various drugs, which were of the greatest value; in fact, it only required that diligence which was at present being put in motion by Commissioner Johnston and others, to much enlarge our knowledge of the valuable commodities to be found in the country. But there was another drawback, that extraordinary phenomenon which had been found to be progressing in all the southern parts of Africa—the desiccation of the country. When he first knew the Shiré river he was on a steamer drawing five feet of water, which took him up to the Shiré cataracts. This was in the month of May; he confessed they were often on sand banks, and had a long job in getting her up, but now he found it was a question of from 9 to 18 inches of water, which showed that the river did not carry the quantity of water it used to in former times, and if this desiccation went on, the Shiré would become un-navigable. He had been struck by what M. Foa said with regard to the shallowness of the Zambesi, showing that that river also was getting more shoal than it used to be. Still he believed the ingenuity of shipbuilders would be equal to the occasion, and produce vessels of very shallow draught to suit these streams. He might be looked upon as a special advocate for Blantyre and the regions of Nyassa as compared with other parts further afield, but he thought it must be a great thing for colonists to be able to go to a place where they found everything they required, including a monthly journal, far better than going into a country where at present there were no Europeans at all. Finally, he wished to say a word on the orthography of African names, in which he was sure he should have the sympathy of the Chairman. About the time that Commissioner Johnston was born, Dr. Livingstone was at work on these rivers, and he was very careful in all he said and wrote. He met various chiefs and discovered various rivers, to which he gave the native names and took down those of the chiefs. He conversed with people belonging principally to two nations, and the curious thing about them was that very many words describing either the name of a man or a place began with the letters "Ch"; for instance, Chibisa was a well-known chief in the country, another was Sochi, and in any old map of the country the names were seen spelt in

this way. But lately all this had been revolutionised by Mr. Johnston, and the names were spelt with "Tsh" instead of "Ch," which he must protest against. They might as well speak of crossing the "Tshannel" and coming to "Tsharing" Cross. He considered it quite ridiculous, for anyone taking up the first number of the *British Central Africa Gazette*, which had just reached England, would find himself quite at a loss to trace out the names used in that enterprising print, simply because they were all spelt in this new-fashioned way. He hoped the Society of Arts and the Geographical Society would set their faces against this irritating alteration.

M. FOA, in reply, said that in speaking of the Chindi, he had not considered the question of transport, or the economy of time, but simply spoken of it from a geographical point of view as to the depth of the water. Even since Mr. Rankin made his exploration, it was quite possible the depth of the river might be changed. Three or four months ago a fine steamer arrived, and was obliged to unload nearly the whole of her cargo in order to get into the Chindi. No doubt the river might be improved, and if this were done its advantages would be recognised, but as it was naturally, it was not able to take the place of a harbour such as Quilimane. Of course, he understood perfectly that there were great advantages in avoiding difficulties with the Portuguese Custom-house, and conveying goods by carriers, and in getting direct to the Zambesi, rather than to the Qua Qua. Still, the fact remained that a steamer with an average cargo could get into the Quilimane when she could not go into the Chindi. He believed that since last year the sands had accumulated at the mouth of the Chindi, especially at the north, until it became very narrow, but next year they might disappear again, because the coast was constantly changing. Lately, a sailing vessel, loaded by Mr. Scharrer, was lost on the bar of the Chindi. She only drew about 8 feet of water, but the passage was very narrow, she missed her way, and was completely lost. With regard to the depth of the Zambesi, and the rate of the current, he had made experiments with a log and floating pieces of wood at several times of the year, and the figure he had given of six or seven knots was the average. The Reverend Mr. Waller admitted that the depth and nature of the River Shire had changed, and it might be that the Zambesi had changed also in the rapidity of the current. He was quite aware that other travellers had crossed the country before him, and he laid no claim to having discovered it. He knew that Dr. Kirk went directly from the Shire river to Tete, to get food, with two or three men, but he only crossed the country in a hurry; he did not leave any description of it. In more modern times Mr. Alfred Sharp, who travelled in the north, and Mr. Rankin, who travelled in Makonga and in Chiuta, had also visited the country, but many places had been, up till the

present, quite unknown to Europeans, though they were very near the tracks made by other travellers. That is why he spoke of it as being new. He knew that steamers for years had been on the river, but they only existed for their own private purposes; they started when they liked, and there was no regularity about them. You never knew whether you could take a passage or not. The steamer of Mr. Scharrer was also in competition with the service of the Company. He had one steamer, two or three lighters, a considerable number of native canoes, but, in the paper, he had been referring to steam transport, which was quick and regular. He might, no doubt, in his brief description, have omitted many things, because to describe such a journey would require a book, and he must therefore ask to be excused if he had forgotten many things. With regard to the orthography of the names, he must say there were great difficulties. In every scientific centre in Europe people pronounced words according to the value of the letters in their own language, and the map which had been shown was prepared for exhibition to French people. Now every word should be pronounced in the same way as it was pronounced by the natives, and consequently you must use such letters as would convey, in the European language, the correct sound. If he had spelt Chindi with a "Ch," as Mr. Waller desired, it would be pronounced "Shinde" by Frenchmen, and therefore in France he was obliged to put a "T" before it, but in the paper he had put "Ch," because it was intended for Englishmen.

The CHAIRMAN, in proposing a vote of thanks to M. Foa, said he thought Mr. Waller would agree with him, as to this vexed question of orthography, that the principle started by Bishop Steer of the value of consonants and letters for spelling African words was most feasible, and independent of national peculiarities, so that every man could read an African map. He was happy to say that the other day at the Foreign Office he was looking at a map prepared by the Intelligence Department, and he found that they were too intelligent to adopt the changes which were so much deprecated. With regard to the bars in the Quilimane and Chindi he might say that the latter was a bar in the mouth of a great river, and was therefore a shifting bar. At the present moment, the Chindi was the way generally used for traffic into the interior, and the Flotilla Company and others had stations and facilities for transport there. The English Concession had its houses, and the Flotilla Company had a hulk and stations where goods could be discharged, stored, and sent away. With regard to the rate of current it must depend a great deal on the season of the year. Both the Zambesi and the Shire were very shallow beyond a certain point, but the resources of science were capable of meeting the difficulty. You could get a steamer, drawing only 11 inches, with coal and water on board, which would tow loaded lighters of the same draught, carrying a

considerable amount of goods—and these rivers gave an enormous advantage to this part of Africa. The great thing to look at in all these reports was the marvellous accuracy and foresight of Dr. Livingstone in his first journey down the Zambesi. He said there was scarcely any part of the world in which you found such a condition of things as great gold-fields surrounding a great coal-field. One of the maps on the table showed the section of a coal seam opposite Tete, 30 feet thick of good coal, which was being used on the river. The country also was very fertile, and the gold deposits were near rivers which were always running. In a dry country you could not work the gold sometimes for want of water. The country was most valuable, not only for its minerals, but also for its vegetable products. They had heard of illness at Blantyre, and they knew of the abandonment of a missionary station near Lake Nyassa; however, not only Mr. Rankin, but M. Foa, Mr. Hanner, and Mr. Waller himself, had all been on the Zambesi a considerable time and managed to survive. He believed some portion of the country to the west of the Shire, where M. Foa had been, would prove in the near future to be more appropriate for a European settlement than Blantyre. Of course, there were certain advantages there which had been referred to, but the best land was all taken up, and therefore there was not much opportunity for those who went afterwards. He concluded by proposing a hearty vote of thanks to M. Foa for his very interesting paper.

The vote of thanks was carried unanimously, and the meeting adjourned.

INDIAN SECTION.

Thursday, March 8, 1894; Right Hon. HENRY CHAPLIN, M.P., in the chair.

The paper read was "The Indian Currency Problem," by J. Barr Robertson.

Tuesday, March 13; Sir ALEXANDER WILSON in the chair. The adjourned discussion was resumed.

The paper, with the whole of the discussion, will be printed in next week's *Journal*.

FIFTEENTH ORDINARY MEETING.

Wednesday, March 14, 1894; FRANCIS COBB, Treasurer of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Flintoff, Robert J., Haxby, Crumpsall-lane, Crumpsall, Manchester.

Gritton, Joseph, Brackenhurst, Redhill, Surrey.

Meldrum, James Jones, Atlantic Works, City-road, Manchester.

Smith, Issac Cardmaw, Springfield, Chelmsford, Essex.

Thackeray, Col. Edward Talbot, R.E., C.B., V.C., 128, Upper Tulse-hill, S.W., and Athenæum Club, S.W.

Wild, Charles J., Weybank, Broadwater, Godalming, and 113, Cheapside, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Fyfe-Jamieson, James Fleming, M.A., LL.B., South Kensington Hotel, Queen's-gate-terrace, S.W.

Gaynor, Captain H. F., R.E., School of Military Engineering, Chatham.

Middlemore, Thomas, Coleshill-lodge, Sutton-Coldfield, near Birmingham.

Saunders, Edward, St. Ann's, Woking, Surrey.

The paper read was—

THE FOUNTAIN AIR-BRUSH.

BY C. L. BURDICK.

The apparatus which I have the pleasure this evening of bringing to the notice of members of this Society is intended to replace the artist's brush or pencil for almost every description of drawing or painting, oil, water-colour, or black and white.

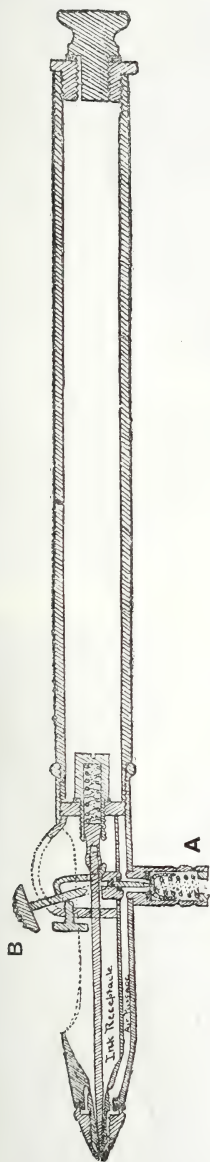
For the information of those unacquainted with the method, it may be stated that the instrument is one for making pictures or drawings by spraying colours on paper or the surfaces of other materials. It is in the form of a pencil or fountain pen. The colour is held in a receptacle near the point, and the pressure of air (from an air-pump worked by the foot) is communicated to and through the pen by a flexible india-rubber tubing. The spray is regulated by means of a small button, worked by the finger. A downward pressure starts the spray. Moving the button forward or backward diminishes or increases respectively the quantity of colour distributed. With the pen near the surface a fine line is given; at a greater distance, a broader line; and still further away, a lighter and broader shadow.

The construction is shown in the diagram on p. 345, the lower figure in which gives the external appearance of the instrument, while the upper figure gives the internal arrangement.

An apparatus of this sort has long been known and carefully employed for working up photographic pictures, but in its present form a much more extended sphere of usefulness is anticipated for it, as it is confidently expected that it will, for many purposes, entirely replace the ordinary brush, since by its use certain

effects can be obtained which a brush is entirely unable to produce.

My principal object this evening is to demonstrate, by actual use, the capacities of this instrument, since it is only by such practical demonstration and trial that its capacities can be appreciated.



A NOZZLE FOR FLEXIBLE TUBE. B BUTTON FOR REGULATING SUPPLY OF PIGMENT.



the walls, and the ease with which they can be obtained is proved by a very short inspection of the method of working, or in the case of any person who can draw, by a practical trial of the apparatus.

The air-brush differs from an ordinary atomizer or spraying device, in that it is adapted for the perfect control of the amount of colour distributed, and is provided with mechanism for easily and quickly starting or stopping the operation of the tool at the will of the operator.

Another essential quality which an air-brush must possess is a uniform character of spray, *i.e.*, not blotchy or irregular, as would be the case in an ordinary spraying device.

The analogy between an air-brush and an ordinary brush is very close, air being substituted for hair. In the former a current of air is charged with colour, and when it is passed over a surface it deposits the colour thereon, just as a brush deposits the colour with which it is charged.

The rationale of substituting air for hair is that it is softer and more flexible, and does not interpose a more or less hard material to stir up or disarrange the particles of colour after they are deposited. More important still; in the new tool we are able, from its peculiar construction, to so manipulate the current of air and the quantity of colour, as to produce varying lines and shadows which cannot be produced by any half-dozen tools at the artist's command.

I do not claim the original conception of the air-brush, but I think I may safely claim the invention of the first entirely practical tool of its class. The idea was first embodied in a mechanism invented by Mr. Abner Paler, of Iowa, United States of America. This first tool was a box-like case, or handle, containing speed-running machinery for feeding colour in the way of an air blast. To keep this tool in working order one must have great patience and no little knowledge and skill in mechanics. To explain its impracticability I will say that certain parts would only last a week or two, and the pieces to take their place required fitting and most careful adjustment. In this first invention, also, they were unable, from constitutional defects, to produce the sharpness of line possible with the new tool. In the invention which I bring to your notice, I have eliminated three-fourths of the pieces, and done away with speed-running machinery; thus I have only operative parts. The instrument is also made like a pencil, and both the quality and the quantity of the spray greatly improved.

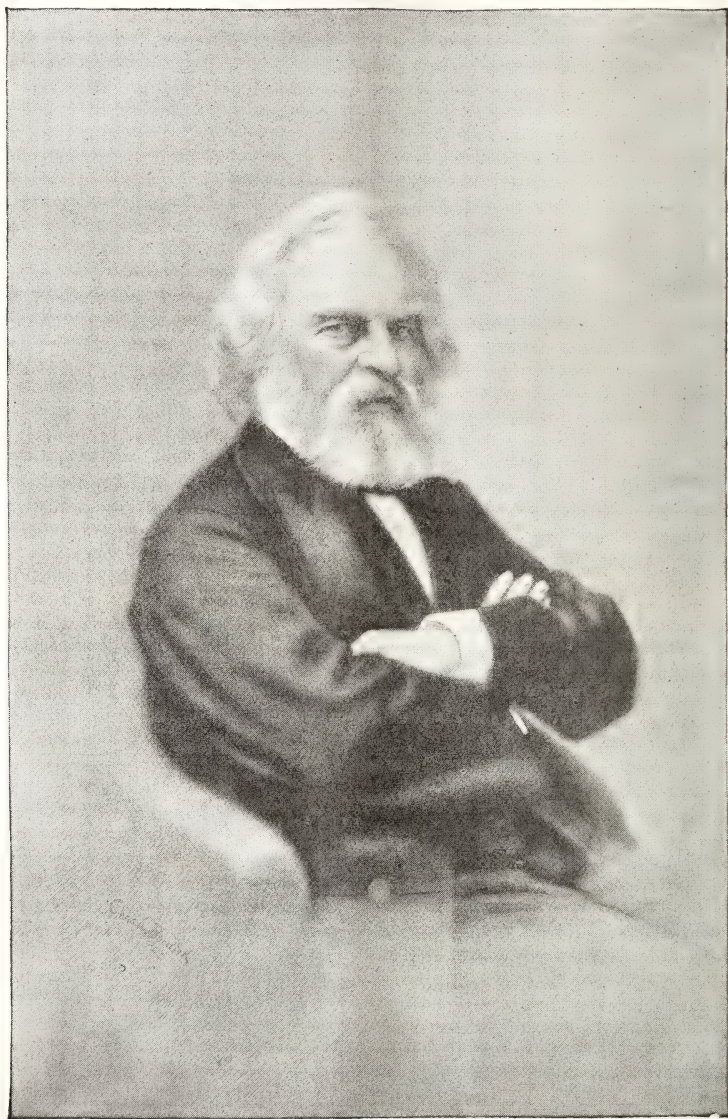
It is difficult for those who have not seen the air-brush at work, or at least inspected pictures produced by it, to believe that such effects can be obtained by means of a jet of air carrying spray in a more or less fine state of subdivision. The results, however, that can be produced are fully shown by the examples on





To describe my invention briefly, I would say that the motive-power is compressed air which, escaping, forms the current of air which we are to charge with the colour to be distributed upon the paper or canvas. This compressed air may be supplied with a foot-pump or other suitable device. The mechanism of the hand-

piece or air-brush proper, consists of two valves, one for the control of the compressed air, and the other for the control of the quantity of the colour. A finger-piece, adapted for two motions, controls these valves and regulates perfectly for every manner of line and shadow. One other important element



PORTRAIT OF H. W. LONGFELLOW.

enters into the manipulation of the tool, and that is the distance at which it is held from the paper.

It will be understood that a current of compressed air escaping from an orifice assumes the form of a cone with its apex at the orifice. We take advantage of this law to vary the

width of line or shadow, the control of the quantity of colour also entering into the result produced. In practice, it may be stated in this way: that for a fine sharp line we should hold the tool close to the surface and reduce the amount of colour to a minimum; for a light thin shadow we should hold the tool away from

the surface with but a small quantity of colour; and for a dark shadow we should employ a large amount of colour, while holding the tool at a distance from the paper.

And now a few words as to the advantages claimed for the method.

An inspection of the work reveals the fact that the colour is deposited in minute particles or specks, virtually a very fine stipple. The surface of the paper showing in the interstices between these particles of colour gives a transparency to the work not to be obtained by wash or stamp; I would also say, in this connection, that the picture will look equally well with the light falling upon it from either side.

A very great advantage is derived from the fact that one wash or layer of colour may be put over another without disturbing the first.

The artist probably has no tool that can equal an air-brush for delicacy of tints; a shadow may be made with a black colour upon a white surface so delicate as not to be visible to the human eye, and only by going over the surface three or four times does it become visible, and this, I may say, refutes a criticism which I have heard that the fingers are more sensitive.

An advantage to the artist is the facility to make lines of varying degrees of sharpness. The fountain air-brush will make a line approximating to the sharpness of a brush or pencil line upon ordinary drawing paper, and from that vary the character of the line to one having great diffusion or lack of definition.

From the facility with which soft lines may be made with the tool, there is a tendency with a beginner to produce too much softness. This can be readily overcome, and as a worker by ordinary methods must exercise care not to produce hardness in his drawing, so with the air-brush will the other extreme need to be avoided.

There are many technical advantages which time will not permit me to mention in detail, I would call attention to the fact that that part of the picture which is being immediately operated upon is not covered with the tool as is the case with the pencil or brush. You may literally watch your shadow grow.

The artist may instantly without change of tool or change of colour go from line to shadow; light or dark. Not of the least importance is the fact generally acknowledged of a great saving of time by the tool. It means that the artist may place his conception upon paper or canvas before it is dulled or lost in the toil of slower methods.

I need hardly tell you that the method is not a mechanical one; the whole purpose of the tool is to remove technical difficulties from the artist's way, to shorten the distance between the picture in the mind and its realisation upon canvas.

I can say from a short experience that artists express their own individuality just as with older methods, and that from its facility of expression it tends to encourage original or ideal work.

[After the reading of the paper, Mr. Burdick demonstrated the use of the instrument, and made several drawings with it. The illustrations to this paper are copied from drawings which have been made by the author with the air brush.]

DISCUSSION.

The CHAIRMAN said the subject was one which did not admit of much discussion, but he should be very glad to hear any remarks from those present, and also any questions that anyone might desire to put. He had no doubt they had noticed that Mr. Burdick, in making the drawings, had used his foot from time to time in connection with the pressure of air, and also had watched the gauge at the top of the easel; and no doubt he would explain more in detail the action of these.

Mr. T. R. ABLETT said he should be glad to know the cost of the apparatus. He considered it would be exceedingly useful to art students, to whom the cost was an important matter. In art studies it was certainly desirable that students should acquire the handicraft of drawing and painting with as little delay as possible. One great difficulty in the way of acquiring the art of drawing was that of getting the instrument to do what you wished on the paper, Young children found it extremely hard to get the pencil to travel in the direction they wished it to go, and one advantage of the apparatus was that the friction which naturally existed between a hard pencil and the paper was obviated. It was really like drawing in the air, and reminded one of the old-fashioned plan of teaching children to learn to write upon loose sand on a tray. A good many of the difficulties which art students and young children met with in their first steps seemed to be overcome by the air-brush. The rapidity with which the drawings had been made showed that students could obtain effects very rapidly. In order that any principle should be thoroughly learned by a student, it was necessary that he should try a number of experiments, and if this instrument saved time in that respect it was a most important thing, as a student could spread the tone and get the effects very quickly. He quite followed what Mr. Burdick said

about putting light on the dark. In order to hide the dark parts it would be necessary to pour on a faint colour, and the beauty of a drawing of that description depended upon the texture. To work the process thoroughly it would be necessary to follow the method employed in transparent water-colour painting: first by putting the light, and then by working up to the dark step by step. This appeared to him to be a method which would considerably curtail the labour now imposed upon art students. If students had a long process to go through before acquiring the art they grew old, and their youthful desires and fancies passed away before they could realise them.

Mr. J. FELL REDMAN said he would not criticise the artistic work of Mr. Burdick, but he might be permitted to point out that, as a matter of fact, he had invented an instrument over a year ago for painting ships' bottoms, the pressure which he used being 35 lbs. to the square inch. With this instrument he blew paint on to the ship with the result that the film was very thin. Boiled oil was blown on by the same method, and a film was obtained infinitely thinner than could be got by means of a brush.

Lieutenant-Colonel ALLAN CUNNINGHAM, R.E., said when he first saw the announcement of the paper, he had not the least idea what an air-brush was, so that he came to the meeting with a mind perfectly open. He had been very much pleased at the wonderful effects produced; and he could not but compliment the inventor of the instrument for the great mechanical perfection to which it had been brought. He should be glad to know how the pressure was managed and the material of which the pen was made. The instances on the wall were all figure subjects, and he should like to know whether the brush, as now made, was fit for drawing fine lines as in architectural studies.

The CHAIRMAN asked whether Mr. Burdick had ever used acid in the brush, and whether by the application of the brush anything could be done in the shape of biting in or etching. He should also like to know with regard to painting upon porcelain whether it could be done so that the design might be burnt in afterwards. He knew that some amateur photographers made a dash at once to adapt this instrument to re-touching their plates, but whether they had been successful or not he did not know. If by the quick combination of colour the colours could be blended, they would have something which would produce a most beautiful picture.

Mr. BURDICK, in reply to a question, said there was no reason why the instrument should not be used for landscape sketching, the only inconvenience would be the trouble of carrying the instrument round. He knew one artist who had done some

very creditable landscape sketches. The tool had greater adaptability probably for portrait work and modelling, as the work could be done in a fiftieth part of the time that was usually occupied. The air was forced in by pushing the pedal with the foot. In the United States some artists used a small electric motor for forcing air. Any motor that would furnish 8 or 10 lbs. of air would do. The effect was varied by a higher or lower pressure of air. With a high pressure a light effect was produced. The pressure gauge was to register the number of pounds. The whole pressure was provided by the float, and it only took a few strokes to fill the air reservoir. When he started to make the sketches that evening the reservoir was empty, and he filled it with a few strokes. The air pump which he used was his own design. The pump had not to be continuously used, as they had no doubt noticed. He was able to make a drawing without a stroke. The tool possessed two valves, a downward pressure let the air off, and when pushed forward it would make a fine mark. The air-valve was really unimportant. You had to control the air and also the colour. The work was corrected, if necessary, with an ink eraser, and he depended a good deal upon the ink eraser for taking out the lights. In most of his work he went slowly at first, making the shadows light, and if it became necessary afterwards to change the expression, he darkened the colour. The colour was not easily erased. For decorative work a design could be made with chalk lines, over which the white could be sprayed, and then the chalk lines dusted off. This did not give so stiff an effect as stopping with paper did. The price of the air-brush, complete, in the United States, was \$33½. The drawing did not rub off. Straight lines could be made with a straight edge. He considered that the instrument would be a very great gain to students in learning to draw. He used the old air-brush some ten years ago, and had enough skill to keep it in order, and so got along better than most workers did, but after he got used to it he was able to get results so much quicker that he learnt things faster than he did when working with crayon.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. Burdick for his interesting paper.

Correspondence.

THE ANTWERP EXHIBITION.

Mr. E. A. WÜNSCH writes:—There is one point raised in the discussion following upon Mr. Sève's paper to which I would beg leave to advert, and I may say that my statements are founded upon the experience of a lifetime in the foreign export trade.

I refer to the reputed inertness and indifference of the British manufacturer in pushing his wares in foreign markets, and his neglect in studying the tastes of the consumers. We are allowing ourselves to be beaten by the foreigner, is the cry resounding on all sides, so far as consular reports are concerned; but there is an astonishing misconception and want of thorough investigation on the part of those on whom devolves the responsibility of these reports. I make bold to say that, at any time within the past half-century and up to the present moment, British manufactured goods have been, and are being, pushed in foreign markets in as efficient and persistent a manner as those of any other nation, the Germans not excepted. I may say that they are even pushed more effectually and practically, in so far as sound trading and safety of capital are the test of efficiency in commerce. Not long ago, in one of these consular reports respecting the trade with Roumania, there was the usual lamentation that the slothful English manufacturer had entirely neglected the market, while the Germans had pushed the sale of their goods to such an extent that the unbusinesslike buyers had their stores crowded with goods which they could not sell, with the disastrous result that many failures took place, and the German manufacturers had to bear the loss. One could therefore only commend the prudence of the English manufacturer, or his representative, in refraining from pushing his goods in a comparatively untried market, with untried customers, and, consequently, at the risk of loss to himself. But as far as the principal branch, the export trade in "dry goods," as they are called, the produce of Manchester, Glasgow, Bradford, and Nottingham is concerned, it is the rarest exception for any manufacturer to attempt to sell his own goods direct to consumers in foreign markets. Taking Manchester as the central and typical place, the whole of the foreign export trade, with the exception of some Indian and colonial firms buying direct, is done by commission houses of foreign nationality or foreign extraction—German, French, Spanish, and even Greek and Armenian, settled at Manchester, the Germans predominating, who act as brokers or middlemen, and also as bankers. When foreign buyers of all nationalities come to Manchester—as they do periodically in shoals—the invariable rule is for each to have his own selected agent, probably his business friend of many years' standing, with whom terms of credit are agreed upon, and in whose name and under whose guidance and advice the goods are bought and paid for by him; and it is these firms, many of them carried on in the second generation, old-established, and rich, who send out their travellers with patterns of every imaginable class of goods, to every country and to every buyer that can pay for them, and execute orders and ship goods at their own risk, often on long credit, while they pay cash to the manufacturer at home, and thus enable him to produce his goods on the very

lowest terms. I remember years ago one firm at Manchester, engaged in this class of trade, who had fourteen patternmakers constantly employed in making up the pattern-cards of the goods shipped, and in getting up the sample sets for the numerous travellers sent out by them, not only to all continental countries, but also to the West Indies, the United States, Mexico, and other South American markets. The travellers who carry these samples, if not the sons or relations of partners, may be young men trained in the firm, or they may be, and in most cases are, of various nationalities, Germans, Italians, or Swiss, selected on account of their polyglot accomplishments and their special knowledge of some particular countries. This class of travellers, being mostly paid on commission, also act at the same time and on the same terms for German, French, and Swiss manufacturers whose patterns they carry, and as they are positively swarming all over the Continent periodically, the report of their doings, of their carrying everything before them, reaches the sacred precincts of our consular and ambassadorial offices in the perverted forms, that the Germans and other foreigners are doing all the trade, and that the ponderous and unaccommodating British manufacturer is left stranded and shut out. As for meeting foreign competition, the facts above referred to will naturally carry with them the inference that British manufacturers, through these commission houses and their travellers, are thoroughly posted up in all that their foreign competitors can do. There are English and German printers on such terms of courtesy with each other as regularly to exchange samples of their productions, and it is quite a common thing for a foreign buyer to bring over with him samples of French, German, or Belgian prints, and hold them up boastfully to the printers on this side, saying how superior or how much cheaper these continental goods are, but he ends by buying, on this side, the class of goods that he can get neither so cheap nor so suitable anywhere else; and many Germans settled in foreign markets, however much they might feel inclined to favour their own countrymen, are compelled to buy the bulk of their goods of English manufacture, because no others will suit their market so well. It is a fact, within my personal knowledge, that at the time the Germans held Zanzibar and were supposed to do an immense trade in German goods to the exclusion of English, the exports of the largest German house at Hamburg, trading to Zanzibar, were made up of English goods to the extent of 70 per cent. One word more, in conclusion, with regard to the equally prevailing fallacy as to the falling off in our export trade. Our export trade fluctuates, but does not fall off on the average of years. During the last few years there has been a temporary falling off, both real and apparent. Real, through temporary causes, such as the disturbed financial and political state of important foreign markets, such as Chili, the Argentine Republic, and latterly the Brazils, and last, but not least, the insane McKinlay tariff in the United

States. Apparent, through the general fall in prices, so that though the same quantities be exported, the value, as compared with former years, is very much reduced, but practically and with the reservations quoted, the movement in the value and quantity of our exports is still onward and upward.

GOLDSMITHS' WORK.

Mrs. PHILIP NEWMAN's answer to Mr. Streeter's letter (see *ante* p. 322) was printed in *The Times*, March 6, as follows:—"Will you permit me to observe on Mr. Streeter's remarks in your issue of yesterday that he is in error if he thinks I said 'that 22 carat gold is the highest standard that can be reached'? What I did say in my lecture before the Society of Arts on the 27th ult., and maintained in the reply to the discussion which followed, was that it is not practical to work chemically pure gold. That Mr. Streeter has worked gold of $23\frac{3}{8}$ carat fineness is neither surprising nor a contradiction to my statement."

General Notes.

PRIZES FOR STREET CABS.—Notice of the prizes offered by Mr. G. A. Thrupp for designs for improved cabs was given in the *Journal* for January 12 (see p. 130). Thirty drawings have been sent in, in response to that offer, and they are now on exhibition in the gallery of the Carriage Bazaar, Baker-street entrance, and will remain until April. Admittance free. Prizes to the amount of £24 have been awarded for seven of the drawings.

GOLD PRODUCTION IN BRITISH GUIANA.—The gold yield of British Guiana in 1893, according to the returns of the Department of Mines, amounted to 142,633 ozs. Compared with the returns of 1892, there appears to be an increase in four districts aggregating 23,262 ozs. 10 dwts. 5 grs., and a decrease of 12,352 ozs. 6 dwts. 20 grs. in five others, the net increase in favour of last year being, therefore, 10,910 ozs. 3 dwts. 9 grs. The larger yield of 1893 was most marked in the Potaro and Cuyuni districts—11,173 ozs. and 9,645 ozs. respectively—next in order being the Barama, 2,278 ozs., and Puruni, 464 ozs. On the other hand, the output from the Essequibo fell short of 1892 by 6,330 ozs.; Barima, 2,914 ozs.; Massaruni, 2,539 ozs.; Demerara River, 378 ozs.; and Grote Creek, 189 ozs.

MEETINGS OF THE SOCIETY.

INDIAN SECTION.

MONDAY, MARCH 19, at 8.30 p.m.—"Indian Railway Extension: its Relation to the Trade of India and of the United Kingdom." By JOSEPH WALTON SIR JAMES KITSON, Bart., M.P., will preside.

* * This Meeting will be held at the Imperial Institute.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 19 ... SOCIETY OF ARTS, 8½ p.m. (Indian Section.) To be held at the Imperial Institute, South Kensington. Mr. Joseph Walton, "Indian Railway Extension: its Relation to the Trades of India and of the United Kingdom."

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute (at the HOUSE OF THE SOCIETY OF ARTS), 4½ p.m. Dr. Joseph Prestwich, "A Possible Cause for the Origin of the Traditions of the Flood" (viewed from a purely scientific standpoint).

TUESDAY, MARCH 20...Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Prof. A. Bostock Hill, "Trade Nuisances."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Mr. Ernest Collins's paper, "The Prevention and Detection of Waste of Water."

Statistical, Geological Museum, Jermyn-street, S.W., 7½ p.m. Mr. Charles Booth, "Statistics of Pauperism in Old Age."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. F. G. Parsons, "The Myology of the Sciuriforme and Hystricomorphe Rodents." 2. Babu Ram Bramha Sanyál, "Notes on *Cynogale bennetti*." 3. Dr. R. W. Shufeldt, "The Osteology of certain Cranes, Rails, and their allies, with remarks upon their affinities."

WEDNESDAY, MARCH 21...Meteorological, 25, Great George-street, S.W., 8 p.m. 1. Mr. W. H. Dines, "Relation between the Mean Quarterly Temperature and the Death-rate." 2. Mr. F. Gaster, "Effect on the Readings of the Dry Bulb of the Close Proximity of the Reservoir of the Wet Bulb Thermometer." 3. Mr. W. H. Dines, "Duration and Lateral Extent of Gusts of Wind, and the Measurement of their Intensity." 4. Dr. K. G. Olsson, "The Calculation of Photographic Cloud Measurements." 5. Mr. R. H. Scott, "Sudden Changes of the Barometer in the Hebrides, on February 23rd, 1894."

Geological, Burlington-house, W., 8 p.m. 1. Mr. Frank Rutley, "The Origin of Certain Novaculites and Quartzites." 2. Mr. W. W. Watts, "Note on the Occurrence of Perlitic Cracks in Quartz."

Microscopical, 20, Hanover-square, W., 8 p.m. Mr. A. D. Michael, "Notes on the Uropodinae."

Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, MARCH 22.—Chemical, Burlington-house, W., 8 p.m. Anniversary Meeting. 1. Presidential Address. 2. Election of Officers and Committee.

Journal of the Society of Arts.

No. 2,157. VOL. XLII.

FRIDAY, MARCH 23, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Chicago Exhibition, 1893.

MEETING OF THE ROYAL COMMISSION.

A meeting of the Royal Commission was held on Monday, 19th inst., at 4.30 p.m. Present:—Sir Richard Webster, G.C.M.G., Q.C., M.P., in the chair; Sir Frederick Abel, Bart., K.C.B., D.C.L., D.Sc., F.R.S., William Anderson, D.C.L., F.R.S., Sir George Birdwood, K.C.I.E., C.S.I., LL.D., M.D., George Ledgard Bristow, Major-Gen. Sir Owen Tudor Burne, K.C.S.I., C.I.E., Michael Carteighe, R. Brudenell Carter, F.R.C.S., Sir George Hayter Chubb, Francis Cobb, Professor James Dewar, M.A., LL.D., F.R.S., Major-General Sir John Donnelly, K.C.B., Sir Henry Doulton, James Dredge, Francis Elgar, LL.D., Professor Clement Le Neve Foster, D.Sc., F.R.S., Sir Douglas Galton, K.C.B., D.C.L., F.R.S., Walter H. Harris, John Biddulph Martin, Florence O'Driscoll, M.P., Sir Westby B. Perceval, K.C.M.G., Sir Owen Roberts, M.A., D.C.L., F.S.A., Professor William Chandler Roberts-Austen, C.B., F.R.S., Sir Albert Kaye Rollit, LL.D., M.P., Sir Saul Samuel, K.C.M.G., C.B., with Sir Henry Trueman Wood, M.A., Secretary.

Proceedings of the Society.

INDIAN SECTION.

Thursday, March 8, 1894; the Right Hon. HENRY CHAPLIN, M.P., in the chair.

The paper read was—

THE INDIAN CURRENCY.

By J. BARR ROBERTSON.

The Indian currency in its practical aspects is one of the most important questions of the

day, and it is with its practical aspects only that I intend to deal. For twenty years causes have been at work that have gradually but steadily lowered the gold value of silver, and to-day the fall has reached a point so far below all reasonable expectations as to amount to a world-wide calamity. Because it must not be supposed that India and the other silver-money countries are the only sufferers by the monetary changes of the last twenty years, or even the chief sufferers. The silver-money countries have in their trade and agriculture been prosperous beyond all comparison with the gold-money countries. On the other hand, the injury and loss to which the gold-money countries have had to submit are so enormous and so widespread, as to be well nigh beyond all calculation. The fall in the gold value of silver is the one great injury that has been inflicted on India, but it is only when Indian officials, or merchants, or people have been concerned in transactions in gold that they have been conscious of change. So far as the whole internal trade and the daily life of the Indian people are concerned, all their transactions and values have been in silver, and of the working of the silver currency there is nothing whatever of which to complain. The Indian people are altogether unconscious of any material change in the last twenty years in prices of their products, and indeed during this period, according to all the Indian authorities, the great body of the people have been in the enjoyment of great, if not even unexampled, prosperity.

It is, therefore, evident that the mass of the people of India know nothing of the silver question, though the Legislatures and Press and platforms of Europe and America have been ringing with it for eighteen years.* Why is it then that this so-called silver question has assumed such formidable proportions in the West, where there is no free coinage of silver, and is so unknown among the people of the East, whose currencies are all of silver? The reason is that the change is in the gold and not in the silver, and thus it is that the people of the East are prospering under silver, while those of Europe and America under gold are compelled to submit to lower and lower prices of commodities and diminishing values of property, and consequently to paralysis of agriculture, trade and industry. The real trouble is not the silver question but the gold question,

* The present writer dealt with the subject in the *Westminster Review*, in two articles, "East Indian Currency and Exchange," in October, 1880, and "Bimetallism and the Finances of India," in January, 1881.

and until this dominating fact in the fortunes of Europe and America is thoroughly realised, there will be no remedy and no relief from the disastrous position into which the gold-money countries have permitted themselves to drift.

While, as has already been said, the mass of the people of India are unconscious of any material change in their property and trading values, they are conscious of a change in the value of gold. In their daily life this would not be of any great moment, but it becomes of considerable importance through the necessity of raising additional taxation to pay a large premium in silver when they come to discharge gold obligations, and particularly the large payments in London. If, then, the cause of all the trouble is to be found in gold, is it not advisable to look for a remedy that will correct, in a greater or less degree, the evils of the present gold-money system? Why is it that, in face of the most absolute proof that there has been no material alteration in values of commodities in silver-money countries, a change is so readily entered on in India, where there is no need of change if only the British Government would apply a remedy to their own appreciated gold currency, which is bringing in its train greater and greater disaster year by year?

SILVER STANDARD VERSUS GOLD STANDARD FOR INDIA BEFORE 1873.

It is believed by some gentlemen of great Indian experience that an irreparable injury was inflicted on India by the decision arrived at, in 1835, to confer the legal tender function exclusively upon silver, and to withdraw it from gold except at the Treasuries, where also it was abolished in 1853. It is contended that if silver had not been made the sole legal tender, and if gold had continued on equal terms with silver, India would not now be involved in serious financial difficulties. Because it must not only be remembered, but be firmly emphasized, that the difficulties of India do not arise from the Indian monetary system. They arise solely and exclusively from the gold obligations payable in London, and but for the enormous increase in the purchasing power of gold in the United Kingdom and other gold-money countries, the gold troubles, which began twenty years ago and became so accentuated as to cause the Indian Government to resort to extraordinary legislation, would never have existed. Had bimetallism been continued in India after 1835 the view of the Indian authorities to whom I

have referred is, that during the period of greatly increased production of gold after 1849 in California and Australia, India would have passed on to the single gold standard, retaining silver for token money with restricted coinage, and with either limited or unlimited legal tender. But as there was no bimetallism in India, and only silver, some of the leading Indian officials urged upon the Home Government the vast importance, when gold was so abundant between 1850 and 1865, of introducing the gold standard, and of relegating silver to a subsidiary position as token money. It may be pointed out, though it is almost self-evident, that if bimetallism had been in existence in India during the period between 1873 and 1876, when France suspended the unrestricted coinage of silver, silver in India would have been deprived of its title to unrestricted coinage, and relegated to a subordinate function, thus following the lead of France and the other countries of the Latin Union. Had bimetallism been in existence in 1873 in India, it can hardly be regarded as possible that the Government of India would have chosen, or the Home Government would have permitted, the demonetization of gold in India rather than the demonetization of silver. In 1876, a Select Committee of the House of Commons sat, under the chairmanship of Mr. Goschen, to consider "the cause of the depreciation of the price of silver, and the effects of such depreciation upon the exchange between India and England," and as early as that period when the gold value of the rupee had fallen to about 1s. 8d., there were demands made by the commercial and official classes of India in favour of the introduction of a gold currency, or at least a gold standard. But, in recent years, the demands for bimetallism or for a gold standard have become louder and deeper.

These considerations in regard to gold in the Indian currency have been set forth in order to show that at successive periods since 1835 the question of adopting the single gold standard was seriously considered. But while the failure to elevate gold, and thus to dethrone silver, is by some Indian authorities regarded as an evil destiny to whose malignant influence India has unhappily had to submit, I venture to think that in retaining silver and rejecting the single gold standard, the stars in their courses were fighting for the people of India. In a paper on "The Currency Problem" which I read on January 19, 1893, before this section of the Society of Arts, I

gave figures in detail to show the movement of the prices of the leading commodities as valued in gold and also in silver. Here I present a Table (p. 356), the first four columns of which were contained in my former paper, except the additions for 1893 and 1894 in Mr. Sauerbeck's figures, and for January 1, 1894, in those of *The Economist*, and Columns V., VI., and VII. are the index numbers of the India Office.

The interpretation of the figures in the above Table will make the issue perfectly clear as between those who lament that the gold standard was not introduced into India before 1873, and those who rejoice that it was not so introduced. The fall in gold prices from £100 which is the average of the prices of commodities according to Mr. Sauerbeck and to *The Economist*, during the years 1865 to 1869, to £67 at the end of 1893, is a fall in prices of 33 per cent., against 32 per cent. at the end of 1892. It will be seen that at the end of January Mr. Sauerbeck's figures had further fallen to 65·8, and at the end of February to 65; so that in the months of January and February the fall in gold prices amounted to 3 per cent. But in column IV. the prices are stated of *The Economist's* commodities as valued in London in bar silver, taking 100 ounces of silver as the average amount required from 1865 to 1869 to purchase a certain quantity of each of the articles in the same way as £100 has been taken for the gold prices. It will be seen that, except in 1889, when the figures of *The Economist* rose to 101 ounces, during the whole period from 1870 to 1892 fewer ounces of silver would purchase the same articles, and thus during all those years silver purchased in London more of the leading commodities than it did from 1865 to 1869. In October 1892, however, 105 ounces of silver were required to purchase the articles, while only £67 were required in gold. On January 1, 1893, 107 ounces of silver were required. It is evident, therefore, that the average gold prices of commodities had fallen in the proportion of 100 to 68 on January 1, 1893, while the average prices in London in silver had moved in the proportion of 100 in 1865-1869 to 107 on January 1, 1893. At the end of 1893, however, the index number of silver prices in London had risen to 129, under the combined influence of the closing of the Indian mints and the suspension of purchases of silver by the United States. Mr. Sauerbeck's index numbers for February 28, 1894, would give an index number of silver prices in London of 142, against 100, in 1865 to 1869.

The Indian index numbers tend to establish the same general result as the silver prices in London. The average index numbers of the two columns of exports and imports at Calcutta show that in the 20 years from 1873 to 1892 silver purchased in India, except in 1874, a larger quantity of commodities than it did in 1873, and it was only in January, 1893, that silver showed that it was slightly depreciating, that is that silver prices rose a little above the level of 1873. It is necessary to point out, however, that the Indian prices are those at Calcutta, a port in communication with the markets of the world. There is no doubt that there have been great fluctuations in the prices of merchandise at interior points in India, where the extension of railways and other facilities of transport have tended to raise the silver prices of goods for export, and to lower the silver prices of articles of import, but these causes have not to any extent affected prices of exports at Calcutta, where the prices to be obtained in the markets of the world have been the dominant factor.

The above figures determine with absolute conclusiveness that if before 1873 India had passed on to the gold standard, as was urged by leading Indian officials, the result would have been disastrous beyond conception. A glance at columns II. and III. will show the movement in gold prices from £100 to £65, a fall of 35 per cent. There is this further consideration, that if India had adopted the gold standard, it would have been an additional country requiring a share of the limited amount of gold in the world, and India's demand for gold for currency would have lowered gold prices still further than 35 per cent. The Indian cultivator would have been compelled to submit to a fall in the prices of his produce of more than 35 per cent., and that would have been an incalculable disaster both for the people and for the Government of India. The Indian people must inevitably have passed through similar experiences to those of England, Scotland and Ireland in the last twenty years. During that period rents in Ireland have fallen by successive stages, and not only have Government Commissions fixed fair rents only to break through them as prices fell lower and lower, but enormous arrears of rent have had to be swept away as it was hopeless to expect they could ever be paid out of the reduced prices. In Scotland the Crofter difficulties have been similar to those of the tenant farmers of Ireland, and in England and Scotland the letting value of

INDEX NUMBERS OF THE GOLD PRICES AND THE SILVER PRICES OF COMMODITIES.

	I.	II.	III.	IV.	V.	VI.	VII.
	Mr. Sauerbeck's Index Numbers.		The Economist Index Numbers.		The India Office Index Numbers.†		
	Gold value of Bar Silver in London. Average of year.	45 leading commodities. — Average of year. — Gold prices.	22 leading commodities. — 100 = 3,102. January 1. — Gold prices.	Prices in Col. III. as valued in London in Bar Silver, January 1. — Silver prices.	Exports at Calcutta. — 20 leading articles. — Silver prices.	Imports at Calcutta. — 11 leading articles. — Silver prices.	Average of Cols. V. & VI. — Exports and Imports at Calcutta. — Silver prices.
	100 = 60'84d. per oz.	Pounds sterling.	Pounds sterling.	Ounces silver.	Rupees.	Rupees.	Rupees.
1865 } to }	100	100	100	100	—	—	—
1869 }							
1870.....	99'6	96	87	87	—	—	—
1871.....	99'7	100	83	83	—	—	—
1872.....	99'2	109	91	91	—	—	—
1873.....	97'4	111	95	96	100	100	100
1874.....	95'8	102	93	95	108	102	105
1875.....	93'3	96	90	94	96	100	98
1876.....	86'7	95	87	95	90	100	95
1877.....	90'2	94	88	93	105	93	99
1878.....	86'4	87	81	91	100	88	94
1879.....	84'2	83	71	87	101	85	93
1880.....	85'9	88	82	95	107	89	98
1881.....	85'0	85	77	91	100	86	93
1882.....	84'9	84	78	91	93	86	89
1883.....	83'1	82	75	90	89	83	86
1884.....	83'3	76	72	86	92	80	86
1885.....	79'9	72	68	82	85	77	81
1886.....	74'6	69	65	84	88	78	83
1887.....	73'3	68	66	87	85	81	83
1888.....	70'4	70	72	98	86	93	89
1889.....	70'2	72	71	101	102	92	97
1890.....	78'4	72	72	98	101	91	96
1891.....	74'1	72	72	90	92	89	90
1892.....	65'4	68	69	95	105	89	97
1893.....	58'3	68	68	107	104	104	104
1894.....	—	—	67	129†	—	—	—
Dec. 31, } 1893.. }	52'2	67	—	—	—	—	—
Jan. 31, } 1894.. }	50'6	65'8	—	—	—	—	—
Feb. 28, } 1894.. }	45'6	65*	—	—	—	—	—

* Mr. Sauerbeck's figures for February 28, 1894, namely 45'6 and 65, would give 142 for the index number of silver prices in London, against 100 in the years 1865-69. This is at 27½d. per ounce of silver.

† The price of bar silver on January 1, 1894, was 31½d. per ounce.

‡ The rupee prices are taken in January and July in each year. The figures for 1893 are for the month of January.

lands has been very greatly reduced. Concurrently with all this distress and disaster among tenant farmers, the landed classes of the United Kingdom have been seriously impoverished and a large proportion of them ruined. Now at the root of all this national disaster there has been but one cause, namely, continually falling prices, and only one remedy could have warded off this widespread impoverishment to all those concerned in the agricultural industry, and that remedy was a continuance of the former range of the prices of agricultural products, or at least of prices not seriously lower. The contraction of the volume of money in gold standard countries rendered the maintenance of the former range of prices impossible, and, therefore, this gold contraction has carried in its train paralysis of trade and industry and widespread national disaster in this and other gold countries. Had India been unfortunate enough to have adopted the single gold standard before 1873, the Indian people must have had to endure much greater loss, privation and distress than our people have ever had to submit to, seeing that they are much more generally engaged in agriculture, and much nearer the starvation point than the population of these islands.

But India was saved by its silver currency from the miseries that would inevitably have been its lot, if it had adopted gold. A glance at column VII. will show that the average of Indian exports and imports from 1875 till 1892 was valued at fewer rupees than in 1873 and 1874, so that, in regard to commodities, silver was appreciated, and it was only in the year 1892-3 that depreciation of silver set in to an extent which, however, was quite insignificant. In the period between 1875 and 1892, therefore, Indian prices were lower than in 1873 and 1874, and the inference from this, and from the imports and coinage of silver in India, is that during that period India did not receive sufficient silver to maintain the level of the prices of 1873 and 1874, though it received a considerable amount. In the year 1892-3, Indian prices rose above the level of 1873, and thus the increased imports and coinage of silver in India in 1890, 1891, and 1892, began to have their natural effect by raising prices from 90 in 1890-1, to 104 in 1892-3. Incalculable disasters have followed the fall in gold prices in this country from 100 to 65, while a very high degree of internal prosperity has followed the comparative steadiness of Indian prices from 1873 till the present time. The populations, therefore, the products of whose

industry have been rated in gold money, have had to pass through a period of depression and impoverishment unparalleled since before the gold discoveries in 1849, and the distress is at present more severe than ever. On the other hand, the populations, like those of India, whose products have been rated in silver money, have pursued the even tenor of their way, in the enjoyment of a fair average range of prices that conferred upon them a degree of comfort and prosperity that would have been impossible if they had had the gold standard.

THE FINANCIAL DIFFICULTIES OF THE INDIAN GOVERNMENT.

While the Indian people have prospered under their silver-money system, they have had one serious financial difficulty with which to contend. The average silver prices of their products continued fairly steady, but owing to the increased purchasing power of gold, when their gold obligations in London had to be discharged, they had to give a much larger number of rupees than formerly to pay off a given amount of sterling. The Table on p. 358 will show how the increased purchasing power of gold over silver operated.

It will be seen, therefore, that the loss that India has sustained by the gradual increase in the purchasing power of gold, as shown in the above column of "Additional amount required," has compelled the Indian Government to raise additional amounts by taxation until, in the year ending March 31, 1893, the additional amount to be raised on this account reached the enormous sum of Rx. 9,946,200, or £9,946,200 at the former rate of 2s. per rupee. If the rate of exchange is not to-day at or near 2s., it is not the fault of silver, which has been in nearly adequate supply for the maintenance of Indian prices, and so has proved in the last 20 years an excellent standard of value. The fault in the absence of bimetallism has been in gold, for which in the last 22 years there has been an enormous new demand by countries formerly using little or no gold, without anything approaching to a corresponding increase in the supply. Besides the additional burden which the contracted gold currency in this country has thrown upon India, serious losses have been inflicted upon the Indian officials, owing to the diminished gold value of the rupee, and upon all those who have money to bring home from India. It may also be noticed that rupee paper, which stood at par both in India and in London 20

years ago, is still at par in India in rupees, but in London its gold price has fallen with the fall in the gold value of the rupee. On the other hand, the gold price of silver fell from 100, in 1865-69, to 65·4 in 1892, to 52·2 on December 31, 1893, and to 45·6 on February 28, 1894.

INDIA COUNCIL BILLS.

Years ended March 31.	Average rate of Exchange on Bills Drawn on India.	Amount received in sterling.	Amount of Bills drawn in London in Rupees.	Additional amount required to be drawn as compared with Ex. change at 2s. the rupee
	s. d.	£	Rx.	Rx
1869..	1 11·197	3,705,741	3,834,000	128,259
1870..	1 11·267	6,980,122	7,200,000	219,878
1871..	1 10·495	8,443,509	9,008,500	564,991
1872..	1 11·126	10,310,339	10,700,000	389,661
1873..	1 10·754	13,939,095	14,702,500	763,405
1874..	1 10·351	13,285,678	14,265,700	980,022
1875..	1 10·156	10,841,615	11,743,700	902,085
1876..	1 9·625	12,389,613	13,750,000	1,360,387
1877..	1 8·508	12,695,799	14,857,512	2,161,713
1878..	1 8·791	10,134,455	11,698,500	1,564,045
1879..	1 7·794	13,948,565	16,912,361	2,963,796
1880..	1 7·961	15,261,810	18,350,000	3,088,190
1881..	1 7·956	15,239,677	18,327,700	3,088,023
1882..	1 7·895	18,412,429	22,210,935	3,798,506
1883..	1 7·525	15,120,521	18,585,659	3,465,138
1884..	1 7·536	17,599,805	21,621,546	4,021,741
1885..	1 7·308	13,758,909	17,102,212	3,343,303
1886..	1 6·254	10,292,692	13,532,537	3,239,845
1887..	1 5·441	12,136,279	16,700,315	4,564,036
1888..	1 4·898	15,358,577	21,812,993	6,453,822
1889..	1 4·379	14,262,859	20,899,122	6,636,263
1890..	1 4·566	15,474,496	22,418,664	6,944,168
1891..	1 6·089	15,969,034	21,186,930	5,217,697
1892..	1 4·733	16,093,854	23,082,811	6,988,958
1893..	1 2·982	16,532,215	26,478,415	9,946,200

The Indian Government had, as will be seen above, to pay in London, during the financial year 1892-3, the sum of £16,532,215, and in consequence of the increased purchasing power of this amount of gold, instead of raising Rx. 16,532,215, the amount it would have required had the rupee continued at 2s., it had to raise at 1s. 2·982d. Rx. 9,946,200 in addition, making in all Rx. 26,478,415. The Committee of 1892-3 on the Indian currency, in referring to the probable further fall in

the gold value of silver, state the case as follows:—"Such a fall would, it may be said with practical certainty, reduce the exchange to about 1s. per rupee, and involve the necessity of raising at least Rx. 6,612,000 more than would be required by the Government of India to effect, even at the rate of exchange of 1s. 3d. per rupee, a remittance of the amount drawn last year, namely, £16,530,000, while the payment of £19,370,000, which is the present estimate of the drawings for 1893-94 would, at 1s. 3d. per rupee, require Rx. 30,992,000, and at 1s. per rupee, Rx. 38,740,000, involving an increase of Rx. 7,748,000." It was this danger of the gold value of the rupee falling to 1s. that induced the Committee to consent to the new monetary policy. It is not contended that all these large amounts of difference between the rupee at 2s. and the lower rates, are loss to the Indian Government, as a certain proportion relates to transactions entered into at lower rates, but by far the larger proportion of the additional amounts needed is actual increase of the burden of taxation.

The raising of these enormous additional amounts by a poor country like India was a formidable addition to its difficulties, while new sources of taxation were not available, and the existing sources had been drained to nearly as great an extent as the Indian Government considered to be consistent with safety. They believed that in the future the additions to the number of rupees that would be required to discharge their gold obligations would become greater and greater, owing to the increase in the purchasing power of gold, and they felt convinced that at no distant date India would be face to face with bankruptcy. Entertaining these views, they abandoned the policy of mere protest and inactivity, and determined that the time had come to enter upon a policy of action, so as, if possible, to ward off the danger of those not very remote contingencies that threatened India with incalculable financial and political disaster.

THE MONETARY PROPOSALS OF THE INDIAN GOVERNMENT.

The Government of India, on March 23, 1892, addressed a despatch to the Secretary of State urging him to give his strongest support to any proposal that might be made by the United States, or any other Government, in connection with an international agreement for the free coinage of gold and silver. The opinion was expressed that the United States would

sooner or later be driven either to the adoption of a silver standard or to the abandonment of its purchases of silver. The Indian Government, therefore, urged that in view of the possible action of the United States the subject should be considered in all its bearings, with the view of protecting Indian interests against the further decline in the gold value of the rupee. On June 21, 1892, the Indian Government sent another despatch announcing that they had heard with satisfaction that her Majesty's Government had accepted the invitation of the United States to take part in an international conference to consider measures for the more extended use of silver as currency. At the same time they expressed their regret that the conference was not summoned for the purpose of considering the adoption of an international agreement for the free coinage of gold and silver, making both gold and silver coins legal tender at a definite ratio. In their opinion a limited increase in the quantity of silver used as currency would exercise only a very trifling influence, if any, in raising the gold price of silver, or in preventing it from falling. In the far more important matter of preventing fluctuations in the gold and silver exchanges and in the relative values of the two metals, it would be wholly without effect. They further regretted the strong opposition to the introduction of the use of silver and gold on equal terms manifested by the British Government, because they believed that no other country would benefit so greatly by a uniform standard of value throughout the civilized world as Great Britain with its vast system of trade and finance, and because the final rejection of an international agreement would place India in greater financial difficulties than ever. They felt by no means confident as to the Conference arriving at a satisfactory conclusion, and if it proved a failure, and a direct agreement between India and the United States was found to be unattainable, they believed their policy ought to be at once to close their mints to the coinage of silver for private holders, and to make arrangements for the introduction of a gold standard.

Accompanying the despatch of June 21, 1892, was a minute by Sir David Barbour, dealing with the details of the new monetary proposal. He estimated that the active rupee circulation, that is, all the rupees that at some period of each year are used as money, amounted to Rs. 115,000,000 as distinguished from the remainder of the existing rupees in India, including hoards. To withdraw all these,

melt them down and sell them in order to introduce a purely gold currency of about £77,000,000, was in his opinion impossible, and, even if it were possible, gold coins would be of too great value for the vast majority of Indian transactions. The great bulk of the Indian currency must continue to be silver rupees. The only measures for the introduction of a gold standard that he regarded as feasible were the following :—

(1) The first measure would be the stoppage of the free coinage of silver, Government retaining the right of purchasing silver and coining it into rupees.

(2) The next measure would be to open the mints to the free coinage of gold. Any person bringing gold to the mints would be entitled to have it coined into gold coins which would be legal tender to any amount. It would be desirable to stop the free coinage of silver some time before opening the mints to the free coinage of gold. It would be a valuable guide to the Government in subsequent proceedings to know exactly what effect the stoppage of the free coinage of silver had on the gold value of the rupee.

In considering the question of the ratio to be adopted between gold and silver, his opinion was that they ought not to think of going back to the old ratio of 1 to 15½. Neither ought they to adopt the very lowest price to which silver might have fallen at any time, nor be bound to accept the market ratio at the time the change might be made. A ratio based on the average price of silver during a limited time before the introduction of the gold standard would probably be both the safest and the most equitable. In his illustrations of the probable operation of the new proposals, he supposes the gold value of the rupee to be fixed at 1s. 4d. thus making 10 rupees in gold equal to 160 pence or two-thirds of a sovereign. The rupee would be raised to 1s. 4d. by contraction of the currency, and the prospect of being unable for a time to effectively establish the gold standard need not, therefore, deter the Government from the attempt to do so if they saw a prospect of success in the future. He intimated that he had changed the opinion he formerly held, and now doubted very much whether rupees would be largely brought out of hoards. He considered that even with a gold standard an increase of the silver rupee currency would be required every year, and that increase he placed at not less than Rs. 1,000,000 and it might be twice or three times as much. While the reduction of

the rupee currency was in progress there would not be an effective gold standard, but he expected that even during that period the exchange with England would be much steadier than it had been during the last few years. He estimated that £15,000,000 of gold would be sufficient to maintain the gold standard, and he regarded it as probable that the substitution of a gold standard for a silver standard would lead to an increased use of gold, instead of silver, for hoarding. He refused to accept the theory that on the introduction of a gold standard a great deal of the gold that is now hoarded or held in the form of ornaments would be brought to the mints, coined and put into circulation.

After the appointment of the committee to which reference will immediately be made the Viceroy, in a telegram dated January. 22, 1893, informed the Secretary of State for India that the Government proposed to take power to issue a notification declaring that English gold coins should be legal tender in India at a rate of not less than $13\frac{1}{2}$ rupees for a sovereign, that is at the rate of 1s. 6d. per rupee.

THE COMMITTEE ON THE INDIAN CURRENCY.

The Home Government had thus to accept the responsibility of deciding as to whether the Indian Government should be permitted to carry out their monetary proposals, the chief of which was the closing of the mints, in the event of the conference, which was to meet at Brussels on Nov. 22, 1892, proving abortive. On October 21 Lord Kimberley, Secretary of State for India, invited Lord Herschell to preside over a committee for the purpose of considering the proposals of the Indian Government, and the Committee included, in addition, Mr. L. H. Courtney, M.P., Sir T. H. Farrer, Bart. (now Lord Farrer), Sir R. E. Welby, Sir A. Godley, General R. Strachey, and Mr. Bertram W. Currie. This Committee took a large amount of evidence which, along with a considerable mass of valuable statistics, and of documents dealing with a great variety of related subjects, was printed in a volume by themselves. The report of the Committee itself is very elaborate, and the conclusion at which they arrive is that they cannot advise the Secretary of State for India to overrule the proposals of the Indian Government for the closing of the mints, and for the adoption of a gold standard. They consider, however, that the following modifications are advisable, namely, that the closing of the

mints against the free coinage of silver should be accompanied by an announcement that, though closed to the public, they will be used by the Government for the coinage of rupees in exchange for gold, at a ratio to be then fixed, say 1s. 4d. per rupee, and not at 1s. 6d., as proposed by the Government; and that at the Government treasuries gold should be received in satisfaction of public dues at the same ratio.

In the section of the report dealing with the "Effect of Fall in Exchange on the People of India and its Commerce," there are some points that call for notice. The Committee state their views thus:—

"In estimating the effect upon the people of India of its being necessary to raise an increased number of rupees to meet the sterling remittances of the Government of that country, it must be borne in mind that the extent of the burthen imposed upon the people of India by these remittances is measured by the quantity of produce which they represent, for it is by export of produce that the debt is in reality discharged.

"In so far as the necessity of exporting more produce arises from the circumstance that gold prices are lower, the people of India are in the same position as those of Australia, or any other country which has to export produce for the purpose of paying the interest on its gold debt. The question to be considered is, what effect has the fall in exchange upon the amount of produce which must be exported to meet a given gold liability? To determine this, the gold price of the produce must be assumed to be stationary. When silver falls in relation to gold the greater number of rupees which is required to meet a given gold payment will not represent a greater quantity of produce than before, if the silver price in India of the produce exported responds to the changed value of silver in relation to gold, *i.e.* if it has risen, or has been prevented from falling. Silver prices must ultimately thus respond, although an interval may elapse before the correspondence is complete; and during this time, whilst more produce is exported, the Indian ryot is getting proportionately less in silver for his produce."

The fact is indisputable that the Indian Government have been compelled, owing to the fall in the rupee exchange, to raise an increasing number of rupees by taxation to meet their gold obligations. It is equally indisputable that the burthen thus imposed is measured by the quantity of produce that has to be sent to this country to discharge these gold obligations.

But what has happened is not a fall in silver in its relation to gold, but a rise in gold in relation to silver; and the change being in the gold and not in the silver, there has been no

rise in silver prices that would cause a larger number of rupees to be required to purchase and export the same amount of produce. In the Report of the Committee reference is made in several passages to silver, as if for many years it had been a depreciating and was now a useless metal; and the whole of the Report is written from this mistaken point of view. A glance at the silver prices of Indian exports in the foregoing Table will show that the average prices of commodities were lower during most of the period from 1873 to 1893 than they were in 1873 and 1874, so that India had to send a largely increased quantity of produce of which even the silver prices were lower than formerly, and thus it had during the greater part of these twenty-one years to meet the double financial embarrassment of a continually falling rate of exchange and a slight fall in silver prices as well, the fall in Indian prices being due to deficiency in the supply of silver offered at the Indian mints. Mr. J. E. O'Connor states in his note on "Levels of Prices" * that generally it may be said that, with the exception of rice (which has shown a distinct upward tendency since 1887) and jute, all the important staples of the export trade have either not increased or have fallen in price." The point to be kept clearly in view is that under a gold standard in England and a silver standard in India, gold prices and silver prices had no relation to each other; they rose and fell independently, each within the orbit of its own influences, just as paper rouble prices do in Russia, paper dollar prices in the Argentine Republic, and as under the closed mints rupee prices now do in India. Owing to the large additional demand for gold in the last twenty-two years, gold has become relatively much scarcer than formerly, that is, gold that ought to have come to this country has gone to other countries that did not formerly possess gold currencies, and there is thus less gold than formerly in the gold countries, while at the same time the volume of its uses has been greatly enlarged owing to increasing population and expanding trade and industry.

It is a very widely-accepted view that the tendency of a falling exchange is to stimulate exports, and the Committee state that "although one may be inclined, regarding the matter theoretically, to accept the proposition that the suggested stimulus would be the result of a falling exchange, an examination of

the statistics of exported produce does not appear to afford any substantial foundation for the view that in practice this stimulus, assuming it to have existed, has had any prevailing effect on the course of trade; on the contrary, the progress of the export trade has been less with a rapidly falling than with a steady exchange." It is frequently asserted that Indian exporters have received a bonus in consequence of the falling exchange. The late Mr. Bagehot and other leading writers have strongly insisted on this as beyond all dispute. But this is one other phase of the misconception that has prevailed, and still prevails, as to what has happened. A bonus on the sale of an article is something that is received by the seller in addition to the ordinary price. On the theory that silver prices had risen in consequence of, and in correspondence with, the falling exchange, it has been argued that there must, therefore, be a higher price than the former price, and this addition in price, supposing it to exist, is called a bonus. But there is no basis for this theory. Silver prices did not rise in India with the falling exchange, in fact, they fell, to some extent, as will be seen in the foregoing Table, and as was amply proved before the Gold and Silver Commission. It will hardly be contended that there is any stimulus to exports in lower prices, and thus Indian exporters received no advantage whatever when the exchange was falling. Of course, fluctuations in exchange may give opportunities for profit, but they also give opportunities for loss. There is, therefore, no ground whatever, theoretical or practical, for the assumption of a stimulus to general exports from India owing to the falling exchange during the last twenty years, except, perhaps, in the last year or two.

What really happened was this. To the Indian exporter the gold rate of exchange kept falling, and at each fall in the rate he got approximately the same number of rupees as formerly, by selling his bills on London for a smaller and smaller amount in sterling as the rate fell. Now if, contrary to the fact, the gold prices in London of Indian produce had remained stationary, the fall in the rate of exchange would have led to a rise in the rupee prices of Indian exports, and that would have given a stimulus to exports. That is, if the gold prices of Indian produce had remained stationary in London, and the gold value of the rupee had fallen, the change that caused the fall in the rate of exchange would have been depreciation of silver, and not

* Report of the Committee on the Indian Currency, Appendix I., page 162.

appreciation of gold, and the views of Mr. Bagehot and others would have applied to that case. But, unfortunately for this theory, the gold prices of Indian produce in London fell just about as rapidly as the gold rate of exchange until very recently, showing beyond the possibility of a doubt that the change was in gold and not in silver. As the change was in the purchasing power of gold, and not in the purchasing power of silver, as, therefore, gold prices fell and silver prices remained comparatively stationary, there was no stimulus given to Indian exports.

It is true, however, that the fall in gold prices, without a corresponding fall in the whole of the factors entering into the cost of production of commodities in this country and other gold standard countries, placed producers under the gold standard at a disadvantage as compared with the producers under the silver standard, and thus the British producers were under a disadvantage in comparison with the more fortunate Indian producers. But the manufacturers of cotton goods and jute goods in this country were by the falling exchange placed also in a very disadvantageous position as compared with their competitors in India, particularly the jute manufacturers, as their raw material is produced only in India, and this gives the Calcutta manufacturers an exceptional advantage. It ought to be mentioned, however, that most of the capital invested in jute mills in Calcutta has been derived from British sources. As the manufacturers of cotton goods in India are now handicapped with a lower rupee exchange in their trade with China and Japan, they are at a disadvantage as compared with cotton manufacturers in China and Japan, and the latter have now an advantage over Indian manufacturers. The prices of cotton goods in China and Japan will rise, and this will benefit the Indian manufacturers, but the manufacturers in these countries will receive an advantage as compared with those in India, as their expenses will not increase to the extent of the rise in prices, and this advantage will be something in the nature of a bonus derived from these currency changes.

India only suffered in connection with its gold obligations and other gold transactions, and in no sense whatever in connection with its silver or rupee obligations. But the strange thing, after 17 years of debates in Parliament, and investigations by Commissions and Committees, is that the British Government still takes but one view, and that

is, that all the disturbances are due to depreciation of silver, whereas it would be difficult to find the slightest ground for this view, and impossible to disprove that nearly the whole of the disturbance is due to the appreciation of gold.

THE CLOSING OF THE MINTS.

The Home Government having empowered the Indian Government to close the mints in terms of the recommendations of the Committee on Indian Currency, the Legislative Council met at Simla on June 26th, 1893, and at a single sitting passed the Bill for carrying the proposals into effect. The only material change that was made in the original proposals of the Indian Government was that gold should be received at the Indian Treasuries, and rupees exchanged for it at the rate of 1s. 4d. per rupee, instead of 1s. 6d. The avowed object of the new proposals being to arrest the further fall in the gold value of the rupee, rather than to raise it, the price of 1s. 4d. per rupee was thought by the Committee to be a sufficiently high limit, and the Indian Government agreed to this. It must not be supposed, however, that there is anything magical in 1s. 4d. It is merely a figure named for the present to define the limit beyond which the gold value of the rupee cannot rise under the present arrangement, and, therefore, it serves the purpose of confining the possible effects of the contraction of the currency within definite and restricted limits.

The Indian mints then were closed because of the enormous additional loss that might have fallen upon the Indian Government, with its mints open, if the United States had suspended their purchases of silver. There are two serious objections that can be urged against the policy of closing the mints. One objection is that the sudden suspension of coinage was a terrible mistake, considering that there was no certainty whatever that the United States would suspend their purchases of silver. I called it at the time a "colossal outrage" perpetrated on the United States, France, Belgium, Italy, Holland, and Spain, not to speak of China, Japan, and Mexico, which had been the friends of India during the last ten years in endeavouring to get bimetalism restored. It is true that there was a movement in the United States in favour of reducing the amount of the silver to be purchased. The policy, therefore, of suddenly closing the Indian mints forced down the price of silver, and made the position of the United States as

the purchasers of 54,000,000 ounces per annum so untenable that the purchase clauses of the Sherman Act were repealed. The Indian Government might have intimated to the United States, France, and Germany that if no bimetallic arrangement could be arrived at the Indian mints would within a certain time be closed. In this way the Government would have taken advantage of their authority to close the mints to force a renewed consideration of the question among the leading Governments. It is worthy of mention that Sir David Barbour, as we now know, was opposed to the sudden closing of the mints without any opportunity being given to the leading Governments to consider their position in view of the prospect of the mints being closed.

The second objection is not to the closing of the mints suddenly, but to the policy of closing the mints at all. Sir D. Barbour takes the view that the Indian Government should not have anticipated a decision in the United States adverse to silver. The power to close the mints in the hands of the Indian Government might have failed to bring about a bimetallic arrangement, but it would in all probability have led the United States to continue their purchases of silver though it might be on a reduced scale, and perhaps France might also have taken some steps in the direction of purchasing silver. To the Indian Government the responsibility of deciding between closing the mints and keeping them open was one involving the gravest issues, and under either policy the Government had to confront most serious difficulties. It can hardly be doubted that between the policy of closing the mints and of keeping them open they embraced the alternative most injurious to India, but it was the policy that seemed to the Government, in the event of the United States suspending their purchases of silver, to be most immediately available for their purposes, and gave greater promise than the policy of keeping the mints open, of enabling them to arrest the increase in their financial responsibilities which the further fall in the exchange threatened to bring upon them. Apart, however, from the effect on the rate of exchange, the policy was bound to produce such a serious dislocation both in the internal and external trade of India, that from the beginning it was fraught with disaster.

In the policy of taking steps to arrest the further fall of the rupee, and even of contracting the currency to 1s. 4d. per rupee, there is an explanation to be made which has been

almost, if not altogether, lost sight of in the discussion of this question. After 1873, in which year the prices are taken at 100, and 1874 Indian silver prices (as will be seen from column vii. of Table of index numbers) fell to some extent, until January, 1893, when they rose to 104, showing that silver has had a higher purchasing power over commodities during the last 20 years than it had in 1873 and 1874. An examination of the statistics of Indian coinage* will show that the silver offered at the mints in the period from 1873 till 1890 did not increase sufficiently to maintain the level of prices of 1873 with expanding trade and increasing populations. In 1890-1 and 1892-3, however, the amount of silver offered at the mints increased, and it is, therefore, not surprising that prices at Calcutta, Bombay, and other Indian ports, have risen above the level of 1873. As I am considering currency changes only, I expressly exclude the prices in the interior of India from consideration, as exportable articles have in many districts risen in price, and imported articles have fallen, in consequence of improved communication, while I confine myself to prices at Calcutta and other ports in open communication with the markets of the world, and which are, therefore, less affected by local changes. It is evident now that while in the last three years gold prices have fallen, silver prices have slightly risen, and the index number of the prices of the year 1892-3 in India is 104, that is 4 per cent. above the level of 1873. For the first time, therefore, in 20 years, it is legitimate to assert that silver was slightly depreciated, but it cannot be said that in this slight rise there was any cause whatever for interference on the part of the Government. An examination of the coinage statistics in India will show that in the last three years there has on an average been a considerable increase of silver offered at the mints, and there are reasons for believing that if the Indian mints had remained open silver would have been offered in still larger quantity. The slight advance in prices beyond the level of 1873 might, therefore, have increased further, though except for the gold obligations of India, a moderate advance above the prices of 1873 would hardly have been noticed, and it would have been a slight benefit to the producing classes. The Indian Government may, however, fairly contend that notwithstanding occasional demands by

* See "The Currency Problem," by the present writer, in the *Journal of the Society of Arts* for February 3, 1893.

the Indian commercial communities during the last 16 years for the mints to be closed, if bimetallism could not be obtained, they refrained from yielding to these demands when silver was appreciated. But when prices had risen above the level of 1873, and silver was slightly depreciated, and promised to become more so, the reasons against contracting the currency to a small extent no longer existed, as the contraction even to 1s. 4d. was not likely to bring prices appreciably below the level of the prices of 1873, or so low as the average of the 20 years since 1873, namely 92, seeing that the average of rupee prices in January, 1893, was 104.

The policy of the Indian Government, however mistaken in its inception, may, therefore, with truth be said to have been calculated to arrest the depreciation of coined silver that had set in and threatened to become greater, and thus to keep Indian prices at or near the level of 1873. So that if the Indian Government should succeed in due time in getting the rupee raised to 1s. 4d., it is very improbable that this contraction of the rupee currency will lower prices to the level of the average of the last 20 years, during which the agricultural classes of India have enjoyed very great prosperity. There is one other consideration that ought to be presented. There is a probability that English prices will still further fall, that is, that gold, the purchasing power of which has increased about 50 per cent. since the years 1865 to 1869, will increase still further in purchasing power, and this will be shown in a further fall of gold prices. But at 1s. 4d., gold will have increased in purchasing power 50 per cent., as compared with silver when the rupee was formerly at 2s.; and thus while India may pass on to the gold standard at 1s. 4d., the adoption of that rate will fix Indian prices as compared with English prices at a level 50 per cent. higher than existed between them before 1873. Or to put it differently, when Indian prices are at 150, English prices will be at 100; that is, English prices will be 33 per cent. below the relative level between English and Indian prices before 1873. If after the exchange reaches 1s. 4d. Indian prices should fall in accordance with a fall in English prices, India will at least have been saved from the fall of 33 per cent. that has already taken place in English prices. To put the general result more clearly in figures, the rupee exchange at 1s. 4d. will have the effect of determining that whereas with the exchange approximately at 2s., £100 and

1,000 rupees were equal in purchasing power, the exchange at 1s. 4d. will cause £100 to be equal to 1,500 rupees, that is 50 per cent. added to 1,000 rupees, and all Indian prices will be 50 per cent. higher as compared with English prices than they were when the exchange was 2s. As however, the real change is in gold and not in silver, the true comparison is that whereas formerly with the rate at 2s. £100 and 1,000 rupees were equivalent, at the rate of 1s. 4d., £67 will be equivalent to 1,000 rupees, and these will have just about the same purchasing power as £100 and 1,000 rupees had in 1873. This fall of 33 per cent. in gold prices without practically any change in Indian prices, will be due solely and exclusively to currency causes, and will have nothing whatever to do with changes from any other causes. This will be perfectly evident when it is considered that it is the same articles that are valued in gold and in rupees, and, therefore, all changes due to other than currency causes are equally in the gold valuation and the rupee valuation. But gold having increased in purchasing power by 50 per cent. since 1865-69 as compared with rupees, rupee prices of commodities will at 1s. 4d. be 50 per cent. higher than gold prices of commodities as compared with rupee prices and gold prices of commodities 25 years ago.

THE EFFECTS OF THE SUSPENSION OF COINAGE.

The last sale of Council bills before the closing of the mints was at 1s. 2½d. with a downward tendency, and this was practically the value in gold of the amount of silver in the rupee. But the closing of the mints, and the shutting out of silver from coinage, deprived silver of its most important customer after the United States, and thus threw upon the remaining markets of the world, namely, the Straits, China, Japan, Mexico, Peru, and Bolivia, an increased supply. Silver immediately fell considerably below the rupee in price, because the silver shut out from India pressed upon the silver markets and lowered the price. In the meantime, the United States followed the example of India in abandoning silver, and suspended their purchases, so that this carried the gold value of silver to a still lower point. But it is worthy of record that, as India had for more than ten years urged bimetallism as the only satisfactory remedy for its financial troubles arising out of the increase in the purchasing power of gold, so the United States,

in the Bill repealing the purchase clauses of the Sherman Act, declared that, notwithstanding that repeal, international bimetallism was the avowed monetary policy of the United States. The first effect of the suspension of the Indian coinage was to reduce the volume of Indian exports and increase the volume of imports in the trade with silver countries. The marked fall in the rupee exchanges between India and silver-using countries like the Straits, China, and Japan, enabled produce from these countries to be laid down in India, where there was no fall in prices, much more cheaply than before. There was not immediately a rise of prices in these countries corresponding to the rapid fall in the rupee exchanges, though a rise in prices was certain to take place in a very short time. When the rise in prices took place the native producer got an advantage which must have stimulated exports, though his goods would not be laid down in India so cheaply as at the time immediately following the closing of the mints and the rapid fall in the rupee exchange with silver countries. This was the case of a falling rupee exchange owing to closed mints in India and increased supplies of silver in silver countries, without a sudden rise in silver prices. The consequence was, that exports were stimulated from the silver countries to India, owing to the fall in exchange without any change in the prices of goods in India, and imports from India were checked; or, to state it differently, imports from silver countries into India were stimulated, while exports from India to these countries were checked. The rise in prices in China and Japan would proceed faster than the increase in the cost of the production, and thus the producer would receive a benefit. The falling rupee exchange in India was, it is to be observed, however, a rising silver exchange in the money of the silver countries, and this is an illustration of the fact that a falling exchange is a rising exchange, depending upon the country in whose money the quotation of exchange is made. Then, owing to the limited amount of Manchester goods in stock in India, and the rise in exchange that took place in consequence of the Secretary of State for India refusing to sell his bills except at a higher price than he could command, there was a large importation of Manchester goods into India.

The increased imports into India from silver-using countries and the check on the exports to those countries was a direct effect of the

sudden fall in the rupee exchanges between those countries and India. On the other hand, as the India Council bills, which ought to have been sold at the rate of about £360,000 a week, were withheld almost altogether, this produced an enormous derangement in the former regular movement of trade and finance, and raised the Indian sterling exchange above its proper level. It is hardly necessary to point out that since the closing of the mints there has been no effective rate of exchange with India until within the last few weeks, when the Secretary of State agreed to take the market rate. In these few weeks increasing amounts of Council bills have been sold. There was, therefore, in simultaneous progress, the enormous derangement of the trade between India and silver-using countries, stimulating imports into India and discouraging exports from India to these countries, and the further enormous derangement produced both in the trade with gold countries and silver countries by the withholding of the Councils bills to which the trade and finance between India and other countries had adapted themselves, and on which reliance was placed for the normal continuance of trade. It is evident that the mere suspension of coinage in India, and the declaration of the intention to establish ultimately a gold standard, did not in themselves produce any immediate change of moment in India itself. The coinage was suspended when the exchange was at rs. 2½d. and from that moment the link between the rupee and silver was broken. How it could have been expected that the rupee currency, rated at rs. 2½d. in gold, should immediately admit of the rupee being rated at rs. 4d., it is difficult to understand. If the mints were closed in order to prevent further additions to the rupee circulation which would have increased its volume and lowered the gold value of the rupee below rs. 2½d., that was no reason for expecting that, without contracting the rupee circulation, the gold value of the rupee should suddenly rise from rs. 2½d. to rs. 4d.

The Indian Government committed an enormous mistake in closing the mints in hot haste as soon as they had received discretionary authority to do so from the Home Government, without attempting to use the fact of this authority having been granted, in order to endeavour to secure with the leading Governments some monetary arrangement which might have saved India from the painful necessity of closing its mints, and of thus introducing endless changes in the channels of

its home production and the direction and character of its trade with outside countries. Had it failed to secure some such arrangement, and had the United States taken the exceedingly improbable step of entirely suspending its purchases of silver, the question of closing the mints would have been one against which fewer objections could have been raised. But the second blunder that the Indian Government committed was in giving any countenance whatever to the theory that the rupee worth 1s. 2½d. could suddenly become worth 1s. 4d. The third blunder, and one most disastrous in its consequences, was in refusing, in deference to the theory that they ought to get a higher rate for their bills, to sell at the market rate, and thus, by withholding their bills, disturbing the exchange market, destroying the former balance between imports and exports, and dislocating in every direction the external trade of India. In addition, the withholding of the Council bills had another serious result. The amount of rupees derived from taxation for the purpose of meeting the Council bills, for a value of about £360,000 per week, accumulated in the Indian treasuries, and as this went on from month to month, it gradually withdrew increasing quantities of rupees from circulation, and ultimately produced a serious stringency in money in India. The rate of discount in Calcutta and Bombay rose from 5 to 10 per cent., and thus the difficulties of the producers, merchants, and the Government were immensely aggravated.

In the meantime the divergence between the gold value of the rupee and the gold value of silver went on increasing, and the effect of this was to offer a considerable benefit to the holders of rupees as against the holders of silver. The consequence was that from countries like the Straits, Zanzibar, Mauritius, &c., where rupees were circulating as silver coins in competition with other silver coins, the increased value of the rupee caused rupees to be returned to India, and thus the Indian currency was increased in volume. The demand for Mexican dollars to take the place of the rupees flowing back to India from outside countries raised the price for a time as high as one penny per ounce above their normal price, as compared with bar silver. Further, it is alleged that rupees have also come out from hoards in India and been replaced by silver, and thus the rupee currency has been increased to an indefinite extent, and the difficulty now is to judge what proportion of the fall in the exchange below 1s. 2½d. is due to the in-

creased amount of rupees added to the circulation since June 26, 1893, and what proportion to the derangement of trade and the complete chaos to which Indian trade has been reduced, and from which it cannot emerge until the Council bills are disposed of, and the trade finally settles itself under the new conditions.

One of the expedients advocated for the purpose of strengthening the rate of exchange was to impose a high import duty on silver. The Indian Government had this proposal under consideration, but they came to the decision that no such duty should be imposed. This import duty was not at first considered as an adjunct to the closing of the mints, though it was put forward as an alternative policy. The Indian commercial communities, having urged the closing of the mints and the fixing of a maximum at which rupees would be exchanged for gold, and finding that there was no possibility of the rate rising to the maximum limit, insisted that a duty should be placed upon the imports of silver. Had this duty been imposed it would only have created another series of dangerous conditions by giving to silver in India a price 15, 20, or 25 per cent. above its value in the other markets of the world. Even when this new series of violent changes had been made, there might have been some temporary effect on the gold value of the rupee due to speculation, but unless the duty had been carried so high that it would have been the wildest flight of adventurous finance, it would, after a brief period of feverish excitement, have had no effect whatever on the rupee currency or on the rate of exchange. Indeed, the duty could only have affected the rupee currency if it had carried the gold price of silver above the gold value of the rupee, and thus have offered a profit on the melting of rupees. Of all the wild schemes of finance conceivable this would have been one of the most extraordinary. The import duty would thus in turn have been bound to fail after having forced endless speculation, and the wildest but most unfounded expectations. The effect, however, of this belief that a duty would be imposed on silver was to force forward large shipments of silver to India, and now that all hope of any high duty is abandoned, the accumulation of speculative silver is depressing the gold value of silver in the markets of the world.

But it is now announced that the Indian Government will impose an import duty of 5 per cent. for revenue purposes on silver and some

other articles. This is not an occasion for a discussion on the policy of import duties, but as silver is so mixed up with the rupee in people's minds, it is the only article of import into India on which it is of the utmost importance that no duty should be imposed. One supreme object now in trying to return to the normal course of trade is to remove all uncertainty as far as possible from the rupee and from silver, whereas the introduction of an import duty will create a difference in price for silver in India from that in the Straits, China, and Japan, and will thus produce a disturbance that will be but very insufficiently compensated by a small revenue to the Indian Government. The announcement just made that this import duty is to be imposed for revenue purposes will now make a higher gold price for silver in India than in China and other silver countries, while the rupee will be much higher still.

The next disturbing expectation that most seriously affected the gold value of the rupee was that the Government were about to re-open the mints to silver. It is easy to see that this expectation worked serious injury, because the rate of exchange that might rule with the mints closed, could not be maintained if the mints were re-opened. In the latter case the rate of exchange was bound to fall, and thus the uncertainty as to this further fall was bound to keep the rate weak, and make it more difficult for the Secretary of State to sell the Council bills. There are, therefore, four causes that have tended to defeat the new policy, namely—(1) The fixing of a limit of rs. 3½d. for the Council bills, and the refusal to sell the bills at market rates; (2) the consequent dislocation of Indian trade with both the East and the West, and the fading out of the surplus exports; (3) the coquetting of the Indian Government with the proposal to impose a high import duty on silver; (5) and the uncertainty as to whether the mints would be re-opened and the rate for Council bills lowered below the figure at which they could be sold if the mints remain closed. As between opening the mints and keeping them closed, now that the position has been so greatly altered for the worse since June 26, 1893, the policy most favourable to the Indian Government is undoubtedly the latter, unless they can persuade the British Government to adopt bimetallism, which would naturally be followed by a re-opening of the Indian mints. At the same time, it is evident that the Indian people will oppose any policy that

calls for additional taxation that can possibly be avoided, and the re-opening of the mints would call for further taxation. It is very probable, therefore, that the Indian mints will not be re-opened for the present, as both the Indian Government and the Indian people will be opposed to it.

THE BALANCE OF INDIAN TRADE.

After having decided to close the mints, and thus dislocate, to the disadvantage of India, the trade with silver-using countries, it is difficult to understand why the Indian Government and the Secretary of State should have proceeded to strike the yet more serious blow at Indian trade by refusing to sell Council bills at the market price. This refusal was a second important cause of the dislocation of the external trade. The mere suspension of the coinage of silver ought to have had little or no immediate effect on India's trade with gold-using countries. But in order that no exceptional effect should have been produced in the interest of India, it was of the utmost importance that the trade should have been continued on the same general lines as formerly. The fact that the course of trade with silver-using countries had been seriously disturbed by the fall in the rupee exchanges with those countries, and that more than half of India's surplus exports were formerly sent to the Straits, China, and Japan, the position of India in regard to the maintenance of its surplus exports was thus already weakened, even if the sales of Council bills had been continued at the market price. The withholding, however, of the Council bills suspended the demand for surplus exports of the amount of £18,000,000, and thus dealt a staggering blow at the possibility of the Indian trade being continued on anything approaching its former normal lines.

Many of the witnesses before the Indian Currency Committee expressed the opinion that with the closing of the mints and the introduction of a gold standard into India the balance of trade might turn against India, and that then it would be impossible to sell Council bills. Some of the witnesses thought that it would be necessary for the Government to adopt measures for the preservation of a favourable balance of trade by the imposition of import duties, and that it might be necessary in connection with such a policy even to export silver rupees at their bullion value. Views were also expressed that silver and Council bills are the ultimate means by which India

balances its trade, and that thus if there was no favourable balance of trade there could be no sales of Council bills.

These opinions, therefore, imply that there is some danger of the Indian Government being unable, though with ample resources in its treasuries, to pay its indebtedness in England. This is indeed a somewhat novel position for a country to be placed in. The Indian Government are to be in possession of ample Indian money to pay in London all their indebtedness at the current rate of exchange, and this money is to be capable of purchasing commodities in India that can be shipped to this country, and yet the Indian Government are by some unexplained process to be debarred from using this money to pay their debts. I think we should look in vain for any such condition of things in the history of modern international indebtedness and modern commerce. It is a very common thing for a country to be unable to pay its debt because it has not the wherewithal to do so, but it is something unheard of that a country should have an overflowing treasury, and yet should have to proclaim *non possumus* to its creditors abroad.

The supposed danger is, in the main, imaginary. India will, under a token silver currency on the gold standard with or without a gold currency, be as able to discharge its indebtedness in England as if it had open mints. It will not require protective duties for currency reasons nor any arbitrary measure on the part of the Government to preserve a favourable balance of trade, nor will it be necessary to export rupees at their bullion value. It is assumed by many persons of authority that the selling of Council bills can only take place when a favourable balance of trade exists, and that, therefore, for this purpose a favourable balance of trade must be maintained at all hazards. But this view arises from a misconception of the *modus operandi* of international commerce and finance. In the present official year India ought to pay in London about £18,700,000. Since the end of June, 1893, the money has accumulated in the treasuries of India that was intended to be applied to the payment from time to time of this indebtedness. Up till the end of June there was a favourable balance of trade, and the Council bills were sold in due course. But it is a complete mistake to suppose that the favourable balance existed independently of the Council bills. The principal reason why there has always been a favourable balance for India is that there has always been Government or

other indebtedness to be discharged in London. So far from the continually favourable balance giving the opportunity for selling the Council bills, the case is just the reverse. There would be no favourable balance independently of the Council bills, as, according to the statistics of Indian trade, if there were no Council bills, the balance of India's external trade would probably be unfavourable.

It will not be disputed that in the trade between two countries neither of which has incurred any indebtedness to the other, exports and imports would balance, so that practically there would not be in regard to either country a balance of either surplus exports or of surplus imports. But if one of the countries were to borrow from the other in order to build railways and make other improvements which would increase its resources, the annual payment of interest would have to be paid in surplus exports from the debtor country to the creditor country, and the principal would also have in due time to be repaid similarly in surplus exports. India is in this position of a debtor country. It owes £18,700,000 in the financial year 1893-94, and it ought to pay this amount in the course of the twelve months in surplus exports. There will be other balances from and to India, and movements of securities also that will modify the amount of the actual final balance. But India has to pay £18,700,000 of which we have exact knowledge, and we also know that this amount must come in exports of merchandise or perhaps to some extent in securities, or even in gold, except in so far as it may be counterbalanced by payments to be made from this country to India in connection with other business.

There is, however, one condition on which the movement of the surplus exports depends. If the payment of the £18,700,000, or of any portion of it, should, by agreement between the Indian Government and the Secretary of State for India, be arranged not to be made, then to the extent of the £18,700,000, or the agreed portion of it, there are no surplus exports needed. The condition, therefore, of the movement of surplus exports from India directly, or indirectly through other countries, to the United Kingdom is, that the amount being due in this country, payment of the amount shall be demanded. If it be not demanded, the surplus exports will not come. Now the process by which demand is made on India to pay its indebtedness to London is by the sale of Council bills. The Council bills once issued the Indian Government must pay,

and when the Indian Government hand over the rupees to the banks in exchange for the Council bills, the banks invest the rupees in bills drawn against shipments of exports, and thus India pays its indebtedness by surplus exports.

It is true that, if there is some serious and rapid change in the conditions of trade, like the rise in exchange from 1s. 4 $\frac{3}{4}$ d. to 1s. 9d. in 1890, the foreign trade will be dislocated by the difficulty in rapidly accommodating the values of commodities to this change. And no doubt this would have been the case to a considerable extent, after the closing of the mints, in the trade between the silver countries and India. But when to this dislocation was added the further serious dislocation produced by the withholding of Council bills because the

banks would not pay an impossible rate for them, it is important to point out that the refusal by the Government to sell Council bills at the market rate had not only no connection with the closing of the mints, but it was a policy that was perfectly certain to add enormously to the difficulties of the position produced by the closing of the mints, and to interfere very seriously with the working out of the new policy.

The following Tables show the movements of the international trade of India, and mark out the results that followed under the combined influence of two distinct causes that ought never to have been authorised so as to act conjointly, and to play havoc with the previously existing normal lines of Indian commerce:—

INDIA.—TOTAL IMPORTS AND EXPORTS, INCLUDING GOVERNMENT STORES AND TREASURE.

	Imports. Average per annum.	Exports. Average per annum.	Surplus Exports per Annum. Average.
FIVE YEARS ended March 31—	Rx.	Rx.	Rx.
1874—78.....	47,176,094	61,538,691	14,362,597
1879—83.....	57,153,750	75,556,735	18,402,985
1884—88.....	72,108,677	88,348,147	16,239,470
1889—93.....	86,259,150	106,399,000	20,049,850
THREE MONTHS.	1891.	1892.	1893.
April 1 to June 30.	Rx.	Rx.	Rx.
Surplus exports.....	9,729,298	10,657,653	10,732,164
SIX MONTHS.	1891.	1892.	1893.
July 1 to December 31.	Rx.	Rx.	Rx.
Surplus exports.....	7,735,822	11,107,802	—
Surplus imports.....	—	—	1,960,511
NINE MONTHS.	1891.	1892.	1893.
April 1 to December 31.	Rx.	Rx.	Rx.
Surplus exports.....	17,465,120	21,765,455	8,761,653

These figures show that the surplus exports in the three months ending June 30, 1893, before the Indian mints were closed, were nearly the same in amount as during the similar period in 1892. But the six months from the closing of the mints to the end of December, 1893, shows surplus imports of Rx. 1,960,511, so that the falling off in surplus exports, and, in addition, the increase of surplus imports, as compared with the corresponding six months in 1892, amounted to no less than Rx. 13,000,000. The surplus exports have, therefore, ceased, and

the balance of trade is now one of surplus imports, a condition of things that can only be reversed by the sale of Council bills, as the balance of trade has with surprising rapidity shown how immediately the absence of Council bills exhibits itself in a corresponding falling off in surplus exports. On the other hand, the net imports of silver into India, in the period of nine months, from April 1st to December 31st, amounted to 19,439,225 ounces, in 1891, to 27,421,440 ounces in 1892, and 37,415,943 ounces in 1893.

THE GOLD STANDARD AND BIMETALLISM.

The Indian Governments of the last 10 or 15 years have urged on the Home Government the enormous importance to the United Kingdom and to India of the adoption of bimetallism in Europe and America, and it is now evident that the failure to consent to bimetallism has brought upon this country a trade depression and general financial distress altogether unparalleled since the period of unrest and suffering that culminated in 1848 in revolutionary movements in nearly every capital in Europe, and from which relief only came by the flow of gold from California and Australia. But while the opinion is rapidly extending that bimetallism ought to have been adopted in the interest of this country, and that thus India should have been saved from the evils of the present monetary policy, and from the danger of bankruptcy which has been declared to be within measurable distance, nevertheless the policy is an existing fact. Condemn it as we may, it is to-day the law in India, and, therefore, it must be considered on its merits. It has already produced enormous injury, but, as I have pointed out, the moment of closing the mints was the very time chosen by both the Indian Government and the Secretary of State to refuse to sell the Council bills at their value in the market. Having closed the mints in the hope that the rupee would not fall further in its gold price, they immediately declared that it ought to rise suddenly 9 or 10 per cent. in its purchasing power over gold and over commodities.

But the policy, considered apart from its disastrous effects on trade, and merely in its currency aspects, is not unworthy of consideration. I differ entirely from those who declare it to be unsound according to the laws that govern currencies. It is not an automatic currency with coins circulating at or near their bullion value, it is a currency of silver coins limited, or that will be limited, in number, and circulating at a higher value than the bullion value of the silver they contain. The object that ought to be aimed at in a currency is to have it sufficient in quantity to cause a certain level of the average prices of the leading commodities to be maintained, and to effect this very important purpose, different expedients have been devised in the use of gold and silver. The distinguishing characteristic of the automatic method is that there shall be open mints for gold or silver, or for both metals, coinage being free of cost or at a small

seignorage. But that is only one method, and, as is now abundantly demonstrated, it has in the last 20 years been a method that has produced very disastrous results, in so far that in the gold countries such as our own it has failed to save us from a fall in prices of 35 per cent. After all, it is the result we are aiming at, and not merely the method of reaching the result, and as the automatic system with gold only has egregiously failed in producing a standard of value, and failed also in maintaining a par of exchange among the nations using one or other or both of the metals, bimetallism is urged as a system which would undeniably give a par of exchange over the world, and would give in the gold countries a more stable standard of value than the single gold standard.

The Indian Government have abandoned one form of the automatic method, namely, having their mints open to silver, and they have arranged conditionally for the ultimate adoption of another form of the automatic method. They have provided that they will deliver out all the rupees that may be demanded in exchange for gold at the rate of 1s. 4d. the rupee, when by the contraction of the currency which they expect from the closing of the mints, the gold value of the rupee rises to 1s. 4d. By this automatic arrangement the rupee can never rise higher than 1s. 4d., as at that figure it will be automatically on the gold standard, and beyond this it cannot pass in its value at the Indian Treasuries. There is, therefore, amid the difficulties in finding perfect monetary expedients at least this merit in the method adopted by the Government, that there is complete control over the maximum limit to which the gold value of the limited rupees may rise.

But though 1s. 4d. is the ultimate destiny of the gold value of the rupee under the present arrangement, there is no prospect of its getting there for an indefinite time to come. The reason of this is obvious. When the mints were closed the rate was 1s. 2½d., and there were a certain number of rupees in circulation. It has already been explained that since that time the silver taken over from the banks was coined into rupees, and old rupees have come out of hoards and have also been returned from abroad. Thus there have been in all probability far more rupees added to the circulation since June 1893, than in any similar period previously, and consequently not only may there not be any contraction of currency, but more probably a considerable expansion of it. Yet must there be contraction before the rate can be

raised. The requisite contraction might be brought about in a short time if the Indian Government were to raise a loan and apply the proceeds to withdrawing rupees from circulation. They could, beyond the possibility of a doubt, raise the rupee to 1s. 4d. in gold if they only bought and withdrew rupees from circulation until, by the diminished number of rupees in circulation, each rupee was worth 1s. 4d. It would, however, be extremely difficult to give even a vague idea of the amount of rupees it might be necessary to withdraw to effect this purpose. But if Sir David Barbour's estimate be taken of the amount of rupees in effective circulation, namely, Rx. 115,000,000, it would not be safe to estimate the number of rupees to be withdrawn at less than Rx. 10,000,000, that is a contraction of about 9 per cent., and it might require double that amount. But even then the materials are wanting on which to found a judgment as to what amount of rupees might come out of hoards, at the increasing gold value of the contracting rupee currency, as compared with the value of silver bars. But, without the withdrawal of a very large quantity of rupees from circulation, the rapid rise of the rupee to 1s. 4d. is simply impossible.

There are, however, two objections to the adoption of this system of rapid contraction of the currency, one is that it would involve the expenditure of a large sum of money which the Government cannot spare, in the purchase of the rupees to be withdrawn; and this expenditure would be entirely unproductive until the expansion of trade caused a demand for rupees at 1s. 4d. in exchange for gold, and permitted the rupees to be put again into circulation. The other objection is that it would be a serious injury to trade and industry if the Government were to bring about a sudden rise of 10 or 15 per cent. in the gold value of the rupee, and thus depress to a corresponding extent the prices of Indian and British goods as valued in rupees. The plan of the Government is undoubtedly the more suitable, namely, to allow India's population and trade to grow up and extend so that a greater demand will be created for money, and this will gradually raise the gold value of the limited number of rupees until it comes to 1s. 4d. Contraction will thus take place, not by withdrawing rupees and afterwards giving them out slowly as trade increases, but by the gradual increase of the business to be done by a limited number of rupees.

There is no doubt that sooner or later this can be done, though there is one element of

uncertainty that will be almost sure to add to the delay in its accomplishment. The Indian mints are closed, and soon the tale of rupees that are to be reckoned in the active circulation will be complete, as from hoards and from abroad old rupees will soon cease to come. If then it be assumed—what no one is likely to deny—that India will continue on its career of development and expansion, it is a matter of absolute certainty that the rupee will gradually increase in purchasing power. But the element of uncertainty is that the rupee may increase in purchasing power, and yet may not rise in its gold value to a corresponding extent. The Indian Government have, by closing the mints, removed the rupee from the vagaries of silver, but they have done this only to link it to the vagaries of gold. Now it appears to be in the highest degree probable that the gold prices of commodities will have a further declining tendency during the present year, unless some important legislation affecting the currencies takes place in one or more of the gold countries.

But if gold prices fall, and they have already fallen from 67 to 65 in January and February, this increased purchasing power of gold will lower the gold value of the rupee, and it is this process of gold prices falling, and the gold rate of the Indian exchange falling, that has been going on almost uninterruptedly for the last 20 years. There will, however, with closed mints and a contracting currency, be a rise in the purchasing power of the rupee, and thus, if gold prices were to remain stationary, the gold value of the rupee would gradually rise. It is evident, therefore, that with a fall in gold prices while rupee prices are stationary, the gold rate of exchange will fall, as it has done during the last 20 years. On the other hand if the rupee currency is contracting while gold prices are stationary, the purchasing power of the rupee will be increased and the gold rate of exchange will rise, according to the expectation of the Indian Government, while rupee prices of commodities will fall. But there is every reason to expect that in the present year gold prices will fall from scarcity of gold, and that rupee prices will fall from scarcity of rupees. The fall in the gold prices would, if it stood alone, be accompanied by a fall in the gold value of the rupee, and the fall in rupee prices, if it stood alone, would be accompanied by a rise in the gold value of the rupee. If then, as there is every reason to expect, gold prices will fall in England, and rupee prices

will fall in India, the consequence will be if they fall equally that the rate of exchange will not be altered, and thus the Indian Government will gain nothing by the contraction of the currency and by the fall in rupee prices. The currency will have contracted to some extent at the end of another 12 months, rupee prices will have fallen to a corresponding extent, but the gold value of the rupee, which the closing of the mints was intended to raise, will have remained unaltered. The reason is that rupees will then purchase more commodities and gold will also purchase more commodities, and thus the gold rate of exchange, or the ratio between gold and the rupee, will not be altered. The element of greatest uncertainty in the Indian currency is now, therefore, the uncertainty as to the degree in which the purchasing power of gold will increase. The tendency of the rupee currency, as soon as rupees cease coming from hoards and from abroad, must be to contract, and for the rupee to purchase more goods than formerly, and more gold also, if gold does not increase in purchasing power. But as the rupee will certainly in the future purchase more goods, while it may or may not purchase more gold even for a number of years, Indian prices will fall while the rate of exchange may fall, or remain unaltered, or rise but very little. It may thus be a long time before the Indian Government shall receive the benefit of 1s. 4d., or even of 1s. 2½d., at which the rate stood when the mints were closed.

If the mints are kept closed, the Council bills will sell at a higher rate than if the mints are opened. There are some vague views drifting about amongst the flotsam and jetsam of this gold, silver, and currency controversy, that if India cannot maintain its favourable balance of trade, it will be compelled to ship rupees and sell them at their bullion value for the purpose of discharging its gold obligations. During all the difficulties in which India has been placed, it has never yet been under the necessity of shipping rupees in order to pay its gold indebtedness; and if this has never happened when the silver in the rupee was worth only 2½ per cent. less than the same weight in bar silver, why should it happen when the silver in the rupee will weigh perhaps 15 per cent. less than the amount of bar silver that will be able to be bought for a rupee? Surely India will find other commodities to export to pay its debts, without having to withdraw rupees from circulation and sell them for bullion, when the rupees would pur-

chase 15 or 20 per cent. more of commodities than the bullion in them would do. Is it possible to suppose that any Government would throw away 15 per cent. out of sheer wantonness? The policy is bad enough, and Governments are sufficiently unwise at times, but to suppose that they will melt down rupees and sell the bullion to pay their debts when the banks will be willing to give them gold in London, or gold bills on London in India for the full value of their rupees, is too great a stretch of imagination to be regarded as possible. After all, commodities in India will be valued in rupees, and merchants will buy those commodities at their rupee value and ship them. Is it conceivable that the Indian Government will refuse to place, as they have always done, their rupees through the banks at the disposal of merchants, but that instead they will melt down the rupees at a loss of 15 per cent., or more or less?

India, with closed mints, will be just as able to pay its debts as with open mints, but it cannot pay its debts either with closed mints or with open mints if it does not sell its Council bills, and does not, thus create the balance of surplus exports which must follow the sales of these bills. There will, with closed mints as with open mints, be times as there have been in the past, when exceptional circumstances will lead wise statesmen not to unduly urge the sale of bills, but this will not be more frequent with closed mints than with open mints.

To the policy of closing the mints, therefore, I see no objection, regarded from the point of view of a currency expedient, as it will work perfectly well as a money system if it is properly carried out. But it has already been seen that the policy could not, even if it had been properly carried out, be put into operation without an enormous dislocation of trade and enormous injury to those engaged in it. No one knows the full ramifications of this dislocation, though in the trade with the Straits, China, and Japan the dislocation and the injury have been so palpable and so immediate, that they have struck even the Indian communities who urged the policy with dismay and despair. To communities, in which the majority had persuaded themselves that with closed mints the rupee could be raised to 1s. 6d. or 1s. 8d. within a few months, basing, on conclusions expressed in a section of the report of the Gold and Silver Commission, their belief that this rise in the rate could be effected without any change in prices and

without any particular effect upon trade, the result of the closing of the mints has been a speedy awakening to the enormous consequences of what they regarded as a comparatively harmless policy. The conclusion referred to, arrived at by the six members of the Gold and Silver Commission who favoured monometallism, was as follows:—"We believe the fall [in prices in England] to be mainly due, at all events, to circumstances independent of changes in the production of, or demand for, the precious metals or the altered relation of silver to gold." The Indian commercial communities seized upon this passage as their justification for the introduction of a gold standard at a high gold value for the rupee without any difficulty, disturbance, or injurious consequences. They argued that if the introduction of a gold standard into Germany, Holland, Denmark, Norway and Sweden, the United States, Italy, and Austria-Hungary, causing a new demand for more than £250,000,000 of gold had little or no effect on gold prices of commodities, then India's demand for £20,000,000 of gold will have infinitely less effect on gold prices, and, therefore, the raising of the gold value of the rupee will have no effect on Indian prices. This was in the whole of the conclusions of the monometallic members of the Gold and Silver Commission the most dangerous, at the same time the most unwarranted by the evidence, and Mr. L. H. Courtney, M.P., who signed it originally, has since intimated that he believes now that the fall in prices was mainly due to the appreciation of gold.

These communities may continue to quote this passage, and to shelter themselves behind it, but in acting upon it they will find it not only a broken reed to lean upon, but one of those misconceptions of facts which, when carried out, will lead, as it has already led, to disaster and to commercial chaos. The vehement objections which they have taken to the Secretary of State selling bills at less than 1s. 4d., and their proposal to send some competent person to supersede the Secretary in the sale of Bills, has its serious as well as its ludicrous side. But it is to be regretted that they have persuaded themselves that the rate of exchange ought not to be less than 1s. 4d. for an article which is only worth 1s. 2d. or less; and so long as they denounce all sales at the market rate, so long will they keep themselves and those who follow their views in a state of agitation and uncertainty, and so long will they continue to inflict upon them-

selves and upon the trade of India tribulation and disaster.

With the suspension of the purchases of silver and of the withholding of about £8,000,000 a year formerly added to the gold standard in the United States, the introduction of a gold standard into India on an automatic basis at 1s. 4d. is much further off than it seemed to be in June 1893, when the mints were closed. The withholding of this addition to the money of the gold countries is equivalent to a failure in the production of the mints of an equal amount. The effect of this can hardly fail to be to produce a further fall in the gold prices of commodities, and with this fall the contraction of the Indian currency will by so much fail to raise the gold price of the rupee, and thus this will delay indefinitely the policy of raising the rupee to 1s. 4d.

But it may be well to offer in conclusion a few brief observations on the proposals for a gold currency in India on the basis of 1s. 4d. the rupee. It will not be denied that the proposal of a gold currency is surrounded with many risks and uncertainties, and so formidable do these seem to be, that even if unhappily all further uncertainty be not at an early date merged in an international monetary arrangement, I venture to express the opinion that even when the rupee rises after an indefinite time to 1s. 4d., the Indian and the British Governments will not have the courage to face the certain injury and the further problematical difficulties by which they will then see the introduction of a gold currency to be surrounded. The experience since June, 1893 of the expectations which both Governments entertained as compared with the widely different effects which resulted from their policy, is not encouraging in the direction of their making further efforts in currency policies. The first doubt is as to the amount of gold that would be necessary to maintain a gold standard in a currency the great mass of which is to consist of silver rupees. Sir David Barbour estimates the amount of gold that will be needed at £15,000,000, and others estimate it at a higher figure. This, then, would have to be withdrawn from the gold currencies of the West, as Sir D. Barbour and others are of opinion that no gold would be sent from hoards to the mints in India unless it was intended to hoard the coins. Though the sum of £15,000,000 is mentioned, yet who can tell what unforeseen circumstances there might be which would require twice as much? The other serious element of doubt is the uncertainty as to what

natives of India would do when bright gold coins came into circulation. Fears have been expressed by persons with experience in India that the habit of hoarding silver, or putting it into ornaments, might change into a habit of similarly using gold, and that, at least, the presence of gold coins might be a temptation to a very extensive demand for gold for such purposes.

There are thus such considerable risks in the introduction of a gold currency that it will, in all probability, never be carried out. In its stead Ricardo's plan of gold bars for export only, which I put forward in discussing this subject 13 years ago,* might be adopted. Silver rupees might be delivered at 1s. 4d. against bar gold without coining the gold, and silver rupees might be received at 1s. 4d. against gold bars for export only. Mr. Lindsay's proposal to have the responsibility transferred to London of giving gold for rupees or rupees for gold would hardly be entertained unless bimetallism were adopted, owing to the indefinite responsibility it would place on the Government or on the Bank of England, and if bimetallism was adopted there would be noneed for a gold standard in India. This method would dispense with the need for a gold coinage, as the Government would give and take gold at 1s. 4d. for silver rupees, and thus render the Indian currency automatic.

A simpler proposal, it seems to me, would be for the Indian Government to deliver silver rupees in exchange for gold, at 1s. 4d., when that rate was once reached, as is proposed in the first part of the new policy. This would keep the gold value of the rupee from rising above the fixed rate, and, as silver would be purchased and rupees would be coined at a profit, the Indian Government would receive gold at 1s. 4d. the rupee, and a profit besides. But there would not be a gold currency, nor would gold bars be provided for export. It is all but perfectly certain that after 1s. 4d. has been reached, the Indian currency will require additions of rupees from time to time to keep the value of the currency from increasing and to maintain prices. Taking the former experience of India, it has invariably coined considerable quantities of silver every year, and if the rate of 1s. 4d. was reached, considerable additions of rupees would have to be made in order to keep the rate from rising above 1s. 4d.

Thus it is evident that the tendency would be for the Indian currency to contract, and for the rate to rise above 1s. 4d. In order to prevent contraction above 1s. 4d., the Government would issue silver rupees against gold at that rate, and they would sell the gold, but as the tendency of the currency would be to contract, there is no danger of its becoming redundant at any time for more than a very brief period, and no danger of the redundancy becoming so great as to produce any material fall in the gold value of the rupee. If, therefore, the Indian Government will accept gold in exchange for rupees, they will provide against the only real danger that will exist in the Indian currency when on the gold standard at 1s. 4d., namely, the danger of contraction. There will, at least, be no need to undertake an indefinite responsibility to provide gold, until, by experience, they have satisfied themselves that such a step is absolutely necessary, and I do not believe any such necessity will arise. If, after awaiting the experience of the rate in rising to 1s. 4d. and in being kept from rising above that rate, by giving rupees in exchange for gold, the Indian Government should find that the currency became redundant, and fell to a considerable extent, then it would be perfectly certain that the cause of the redundancy, and the consequent fall in the exchange was not due to the redundancy of the rupee currency, but to a further rise in the purchasing power of gold, which will be the continual danger of any gold standard policy in the future. I repeat the opinion I gave in my paper before this Society more than a year ago, that there is scarcely any chance that in the future, even with bimetallism, there will be enough gold and silver produced in the world to maintain even the present low level of gold prices for any considerable length of time.

Turn, therefore, in whatever direction we may, the appreciation of gold has laid a blighting hand over the length and breadth of the great civilized countries of the world; it has paralyzed the industries and the trade of nations but lately prosperous and flourishing; it has crippled and ruined whole classes, and its evil genius marches on to accomplish still further the work of ruin which the present monetary system renders inevitable. The gold indebtedness of India was created by Indian officials acting under the authority of the British Government, and, to-day, this gold indebtedness has become such an enormous burden in consequence of the appreciation of

* In Article on "East Indian Currency and Exchange" already referred to.

gold that India is in a condition bordering on insolvency. This gold debt, further burdened by the appreciation of gold, is the one fatal inheritance under which Indian finances are staggering. For internal purposes the resources of Indian taxation are perfectly adequate. The suspension of coinage and the proposed gold standard are at best merely palliatives involving serious drawbacks under conditions that demand a solution, and not merely a palliative.

But while statesmen may affect to treat with a light heart the stupendous interests that are either prostrated or threatened all over the world by the rise in the purchasing power of gold, there is a Nemesis which is surely and swiftly dealing out retribution. The foreign trade of this country unhappily is declining in value, and particularly the exports of British produce on which so many of our workmen rely, while the revenue of the Exchequer is showing a considerable falling off for the year ending March 31st, 1894. The prospect for the future is still less encouraging, prices are still declining and will for some time to come continue to decline, and in face of these conditions trade must continue stagnant and the national revenue must still further fall off. The action of the Indian Government in closing the mints is regarded by themselves as merely a palliative adopted in an exigency of despair. They do not pretend to accept it as a solution. It is merely a momentary breathing space to save them for a time from worse immediate consequences; although perhaps to-day the Indian Government are having it borne in upon them that the former ills were lighter than these later ones. But in these currency troubles of the last 20 years there has been only one solution seriously put forward, and that is to return to the joint standard of gold and silver under which the trade of this country was developed to enormous proportions, under which our empire in so many portions of the globe was so marvelously built up, and under which the West, as contrasted with the East achieved its unrivalled triumphs in the paths of civilization. And I venture to predict that the civilized world will ere long be compelled to return to that former standard, and that then, and not till then, they will be able to cast off the benumbing influence of the decline and retrogression of the last twenty years, and to press forward with confidence and with renewed energy on a new era of progress and prosperity.

DISCUSSION.

The CHAIRMAN said it was usual, on these occasions, for the Chairman to open the discussion, but it was with great diffidence that he did so, having been greatly occupied with other matters, and having had very little time at his disposal to devote to any preparation for it. However, he gladly availed himself of the opportunity of expressing how deeply he, and all present, were indebted to Mr. Barr Robertson for this very able paper. Some difference, no doubt, there would be on various matters with which he had dealt; indeed, it was one of the advantages of such meetings that the freest expressions of opinion was not only expected but invited, so that all sides of the question might be adequately discussed, but there could not be any differences of opinion on two points, first, the enormous importance of this question, and, secondly, that the time selected for the discussion was singularly opportune. It seemed to him that they were rapidly arriving at the time, if it had not already come, when it became possible to form some estimate of the success or failure of the scheme adopted by the Indian Government last June. He need not refer to the circumstances under which that scheme became law further than to remind them that Parliament was allowed no opportunity of expressing any opinion until after the scheme had become law, and that the whole responsibility, therefore, rested on its authors, and on them alone. Many of them vehemently opposed it from the first. It was pointed out at the time, that in the judgment of many people this scheme appeared to be open to every conceivable objection to which a scheme for dealing with currency could be liable. It would be impossible on that occasion to discuss that question exhaustively, but he might mention two or three of what appeared to him to be the most prominent objections to this scheme. The first, and perhaps the most vital of all, was that it was absolutely certain to create an immediate heavy further fall in the value of silver in the future. As a matter of fact, it created such a fall, to the extent of 8d. an ounce in one week, a fact absolutely without parallel in the whole history of the two metals since the world began. Again, by artificially endeavouring to raise, and to some extent by succeeding in raising, the value of the rupee, though not directly, the taxation on the people of India was quite as surely and most insidiously increased; and, secondly, it added to the burden of the debt which rested on the shoulder of every debtor in India. They knew from experience and information what vast numbers of the poorer portion of that country were suffering under the burden of debts already. Thirdly, by creating a divergence between the rupee on the one hand, and the uncoined metal silver on the other, an exchange had been set up between India and the Further East which had practically been already fatal to the favourable balance of trade which India had

hitherto enjoyed, and if they were to believe the statement made in Parliament upon the authority of the Chancellor of the Exchequer himself, they had reduced India almost to the borders of bankruptcy. It was also a fact, in his opinion beyond dispute, if the figures of Mr. F. C. Harrison, which were laid officially before Lord Herschell's committee on behalf of the Indian Government, were correct, that there was in the possession of the natives of India a mass of uncoined silver amounting to 300 crores of rupees, which, at the old value, would represent something like £300,000,000 sterling, and the whole of this enormous property in the hands of the native population had been depreciated by a stroke of the pen, by the arbitrary action of the Government, to an extent which was hardly credible, but which anyone could easily ascertain by calculation. He knew these statements had been denied, and that these assumptions as to the depreciation of native property had been contradicted, but the official figures, upon which they rested, no one had ever attempted to traverse or contradict, and unless those figures were wrong the facts he had stated were absolutely correct. He had mentioned some of the more salient objections to this policy, and he thought they were sufficiently grave, even if that policy had been successful in the main purpose for which it was adopted, namely, to enable the Indian Government to tide over the financial difficulties by which they were surrounded. But it had not even done that, and, as far as they knew, up to the present time, while these financial difficulties were nearly as great as they were before, all these enormous objections had absolutely been incurred in vain. What was the cause of the enormous difficulties in which the Indian Government found themselves? He had always thought that they arose from one cause in the main, and that was because the authorities at home, notably the Secretary of State for India, had always shut their eyes to the fact of the appreciation of gold, which had been going on so steadily now for so many years, and the consequent fall which had occurred, and was still progressing, in the gold value of silver, and all the evils which followed in its train. In justice to the Government of India, it must be remembered that the policy which was sanctioned by the English Government was not the real policy the Indian Government desired and recommended. It was only when that policy, namely, the promotion of an international agreement for the free coinage of both metals had been rejected again and again, that they reluctantly fell back on the only alternative which seemed open to them, and which, with all its risks, they were ready to attempt, namely, the closing of the mints. No one was better aware than himself of the extremely difficult and complicated character of this question, and no one would wish to guard himself more carefully against speaking in anything like a dogmatic manner upon it, but yet, in its main

feature, the whole question in one sense seemed to him to lie almost in a nutshell. In his view, it was not difficult to perceive where the cardinal error had arisen. The fundamental cause which lay at the root of all the financial troubles in India, and which had been the source of all their difficulties for years, was the constant and continuous fall in the value of silver. That was thoroughly admitted both by the Indian and English Governments, and that being so, surely the natural mode of dealing with this question would have been to endeavour to deal with the cause which lay at the root of it, to endeavour to do something at all events to arrest any further fall in the value of silver, and, if possible, to re-establish its value and support it in future. Unhappily, exactly the opposite policy had been followed throughout. Instead of doing anything to arrest the fall of silver, the Government proceeded, immediately after the failure of the Conference at Brussels, to make war upon silver themselves, and in fact blow after blow had been inflicted upon silver, thus aggravating and enormously increasing the fundamental difficulty from which India had been all along suffering, until they arrived at the point when it became impossible to say how much further silver might continue to fall. Now a further hostile step had been taken in the same direction within the last few days by the proposed imposition of an import duty on that metal. It seemed to him impossible to exaggerate the gravity of the situation. What the remedy should be was really a question more for experts like themselves to consider and discuss. He had already in public frequently expressed his own opinion that the only mode of escape from the present difficulty, not only in India, but elsewhere, was by reverting to the policy of former days, and endeavouring to do something to restore silver to its old position in the world, in fact to adopt the policy indicated in this paper. Of course this was only possible by concert among the leading nations of the world, but that those nations were prepared to consider in a friendly spirit any proposals of this nature he did not doubt. It was England alone which stood in the way of such proposals being brought to the front. He need not remind the meeting of the attitude of the President of the United States not many months ago when he obtained from Congress powers to summon a new conference of the nations on this question at any moment which might seem auspicious. Quite recently a Royal Commission had been appointed in Germany to examine into this question and ascertain whether it would be possible for Germany to do anything by itself, or whether an international arrangement was necessary, and from recent information it appeared that the German Emperor himself was taking the deepest interest in the question. All things confirmed him in the belief that there was no indisposition on the part of other nations to consider and deal with this question, but that the difficulty lay in this country alone. He believed the future of this question rested very largely in the hands of gentlemen such as he saw before him,

many of whom he knew had complete and accurate knowledge of the subject, and in their hands he must leave it for the present, while thanking them for the kindness with which they had heard him.

Sir RAYMOND WEST, K.C.I.E., said he had probably been asked to speak first because he was supposed to be in antagonism to the views of the reader of the paper, and no doubt on the last occasion when Mr. Robertson read a paper on a similar subject he differed from him, as he did now on some points, but in many others he agreed with him, and he certainly agreed with the audience at large in appreciating most heartily the value of the paper. The difficulty of this question was admitted by everyone, and that difficulty had been singularly illustrated by what had passed already. A few minutes ago, the Chairman remarked that the marked phenomenon of late years in the financial world had been the fall in the value of silver; whereas, the effect of Mr. Robertson's paper, with which, in a general way, the Chairman agreed, was that there had not been of late years generally a fall in silver, that silver had remained comparatively steady, while there had been, in fact, a great enhancement of gold.

The CHAIRMAN said, what he had intended to say—if he had not done so—was that there was a fall in the gold value of silver.

Sir RAYMOND WEST said another observation fell from the Chairman, in which they all agreed, that there had been an enhancement in gold. To some extent there had been, and probably would be, a considerable enhancement, although it was impossible to say with certainty what the enhancement of a precious metal was, because you had no standard to measure it by, except the value of other things; and, of course, there were no such things as high or low without reference to some particular standard. Still, on a general consideration of the subject, he thought they must attribute the change in the relation between gold and silver and other commodities, not only to an easier production of silver, but to a growing scarcity of gold, and, therefore, to the fact that people valued it more in proportion to other things, and thus there had been what would be ordinarily called an enhancement in the value of gold. But this was a phenomenon which was not explained by merely stating it; it required consideration. If there had been such an enhancement, was it purely accidental, and if not, what was the reason for it? There had not been a falling off in the last 20 or 30 years in the production of gold; on the contrary, there had been an increase, and why was it then that gold had grown in value? He thought the reason was to be found in a consideration of the greatly expanded commerce of the world, and of commerce assuming more and more wholesale dimensions. Looking back into the history of the metals during the last three or four centuries,

it would be found there was a general slightly greater value of gold in proportion to silver in the days when communication was less easy than it now was at the important ports and cities of the world where commerce was chiefly carried on as compared with other places. For instance, in Venice and Florence, in the 15th and 16th centuries, the price of gold in proportion to silver was generally a trifle higher than it was in places remote from those great centres of commerce. The phenomenon observed in more recent years arose from the fact that with the enormous advances of commerce gold had become proportionately a far more convenient medium of exchange than it was formerly, and if that was a natural process it was perfectly useless to contend against it. People would use gold if it were the more convenient metal. If all the Governments agreed that they would have silver, and would not have gold, they could not make merchants, bankers, and dealers in bullion agree with them, nor prevent them using that medium of exchange which, on the whole, was more convenient. The only effect of insisting on such a process as the equalisation or rationisation of silver to gold at a particular fixed rate would be to make people carry on their transactions to a very large extent—as they were now to some extent—in bullion instead of in coined metal. International balances were now settled in bullion. Another observation in connection with this was the uselessness and impolicy of putting a duty on silver. He perfectly agreed with Mr. Robertson's reasoning on that point, but, as one acquainted somewhat with the actual working of things in India, he might add his testimony to this effect, that all along the frontier of 3,000 or 4,000 miles, where it adjoined native States, it would be practically impossible to prevent the introduction into British India of silver to a large extent. There were little fairs and markets held on each side of the frontier, and to prevent the crossing of the frontier by the natives on each side would be an intolerable hardship. There was not a native above the lowest pauper who did not wear some silver ornaments, and his wife and children did the same, and if they went to a fair in a native State and came back with silver ornaments upon them how could you be sure they were or were not smuggled silver? It was clear to his mind, therefore, first of all that smuggling could not be prevented, and, secondly, that any attempt to prevent it would lead to petty exactions and corruption, and would promote disaffection and create enormous difficulties. These objections ought, to a practical statesman, to be quite insuperable. With regard to the relation of silver to the rupee, if there were a free interchange of rupees and uncoined silver, as when the mints were quite open, you could not prevent the silver and rupee moving one with the other, and he believed that with the impending measures in the United States silver would have gone down very considerably even without any closing of the mints in India. As gold came into use more and more, silver

went out of use, and its relative value declined, but that could not be prevented by any arrangements. He believed that, although you could raise the value of the coins, as you could the value of the notes, above their intrinsic value, by making them scarce, yet, in the long run, it would be impossible to maintain the silver rupee in India resting only on itself, materially above that of uncoined silver. Mr. Robertson had pointed out that silver followed the vagaries of gold under the best arrangements proposed hitherto; but he thought, in the existing state of things, without any definite gold standard to refer to, silver rupees at an artificial value would wobble about—and must do—like a balloon in the air. But, he believed also, that if you once got an acknowledgment from the Government of India, that within some reasonable time a gold standard should be established, and that, say for 15 rupees, either of a new coinage or the existing one, £1, or its equivalent, should be given in exchange, you could then maintain the existing rupees certainly very near 1s. 4d. An illustration of that principle was, that during the war from 1797 to 1816, bank notes were maintained, not quite at par, certainly, but still without falling to a very great discount, merely on the promise that they should eventually be exchanged for gold. So, he believed, rupees could be maintained at a considerably higher value than the intrinsic value of the silver they contained; at the same time, he thought a new coinage would be a better arrangement, having more direct reference to the gold for which it was ultimately to be exchanged, and involving only a manageable quantity of silver; and he felt certain that if the gold coins were made of sufficiently large amounts—for instance, that there should be no gold coin under 60 rupees, the business of India was carried on so much in the retail way that the demand for gold coins would be very small, and the arrangement could be carried out with a very small quantity of gold to work with; he believed £10,000,000 would be quite sufficient. He admitted there was a necessity for the use of silver in the world, and the way to use it was to have an exchange by rating from day to day, or week to week, between the two metals, so that the Government or the bank of a country with a gold standard should be at liberty to give silver at the rate of the day, and a country with a silver standard should be at liberty to give gold at the rate of the day. But apart from that it was absolutely impossible, either in England or in India, to counteract the natural operations of commerce, or the natural process by which one metal was produced at a larger or a smaller cost than the other.

Sir W. H. HOULDSWORTH, Bart., M.P., said he should have preferred that someone who agreed less with the paper than he did had had an opportunity of speaking first, so that he might answer some of the points which were put; still he was glad of the opportunity of bearing his testimony to the very great value

of this paper. All that Mr. Robertson gave to the public was the result of most careful thought. He was quite sure that this paper, when it appeared in full, would well repay careful reading. One point that struck him most was one which ought to be constantly kept before the notice of the public, and that was the one raised by Sir Raymond West as to the depreciation of silver or the fall in its value. He had noticed that the Chairman constantly referred to the fall in the value of silver, and, of course, he knew what he meant, namely, the fall in the gold value, which was a very different thing from depreciation. One of the most valuable parts of the paper was the absolute proof, as it seemed to him, that silver had not depreciated, and that there had not been a fall in its value. If there had been a divergence from the old ratio between silver and gold, there was only one explanation, that was the appreciation of gold; and he was glad to hear Sir Raymond West give in his adhesion to that doctrine. Of course, it was not easy to ascertain exactly the extent to which that appreciation had taken place, but the fact was certain. As Sir Raymond West said, they must compare it with something else, and the only thing he knew of to compare it with was commodities. It was the prices of commodities carefully ascertained, and the general level of prices which was the guide as to the appreciation of gold, whether it had occurred at all, and to what extent. Now it was a remarkable thing that the index numbers of six or eight different authorities, working on different plans, practically agreed 6 or 7 per cent. at the outside would cover any difference between the different modes of calculation. Sir Raymond West seemed to have a difficulty in understanding how it was there should be an appreciation of gold when there was so much gold to be had, and such great annual supplies coming in, but he must have forgotten that in determining whether a commodity was increasing in value or not, there was something else to be taken into consideration besides supply, namely, the question of demand. It seemed to him very remarkable that those on the opposite side of this question, knowing, as they must, that it was not supply only, but supply and demand which regulated values, persistently left out the question of demand, and simply presented the figures regarding supply. Again, he quite agreed that the appreciation of gold had not taken place by accident. Taking silver and gold together, the appreciation of our standard of value was not owing to a failure in supply; it had occurred in consequence of legislation. Some years ago both metals were used as the monetary standard, although not in England; yet the French Mint was quite sufficient to keep up the ratio between silver and gold all over the commercial world. But when one metal was thrown out of use, all the immense supplies of it which were coming were debarr'd from entering into the area of the monetary standard, and there could only be one effect. The whole of the work was thrown

on to one metal, and although £20,000,000 or £30,000,000 a year were produced that was not sufficient to meet the demand. Sir Raymond West said the appreciation was owing to the great demand from the extension of commerce. But surely they were not going to stop the extension of commerce in order to keep prices stable. To keep prices stable you ought to use the largest quantity of the precious metals you could get, in order to maintain prices. The point made in the paper with regard to Council bills was very interesting, and, to him, quite new. It was usually considered that a favourable balance of trade created a demand of Council bills, but Mr. Robertson, on the other hand, said that it was the Council bills which produced the favourable balance of trade, and he could not help thinking there was a great deal to be said for that theory, having had the advantage of hearing Mr. Robertson explain it rather more fully than he had done now. He would, therefore, ask anyone interested in this point to read carefully the full text of the paper when it appeared, as they would there find the matter more clearly worked out. With regard to the stimulus on exports he had always taken the view that, as the producer in India did not get a higher silver price for his commodity, he did not see how there could be a stimulus. At the same time he thought there was a stimulus to a certain extent to the exporter when exchange fell. It appeared to him that when exchange fell the price in this country, say of wheat, did not respond to the fall immediately. Those working in the market knew nothing about exchange; they looked to the supply and demand in their own market. But the India merchant was alive to it, and perhaps was anticipating that exchange might fall and made his arrangements accordingly, and if he could sell in this country at the old price, and exchange fell in the meantime he got an extra profit. In that way he believed Indian exporters had been during the last few years on the *qui vive*, and with the excessive falls in exchange had not only made large profits themselves but were induced to send larger exports to this country. With regard to the closing of the mints, he gathered Mr. Robertson's view to be that it was theoretically sound, and that it ought to raise the rupee, but that it would not do it for a long time, and possibly might never do it. It seemed to him that a policy founded on theory which had only such considerations to support it was not worth much, and he was rather disposed to agree with the Chairman that it must be a dangerous policy. The Government were at present making a series of financial experiments. They seemed to be going through the exhaustive process of trying everything they possibly could. It was a serious matter both for India and this country, and he deprecated their obstinate refusal to consider even what had been put forward by the most eminent authorities as the real solution of the difficulty. He believed they would ultimately have to come to it,

but what misery and loss would be borne in the meantime no one could tell.

The discussion was adjourned to Tuesday, 13th inst.

Adjourned discussion, Tuesday, March 13th, 1894; Sir ALEXANDER WILSON in the chair.

Sir GUILFORD MOLESWORTH, K.C.I.E., said Mr. Robertson, in his paper, had drawn attention to a very prevalent and mischievous fallacy, namely, that silver was at the bottom of all the present monetary difficulties. At the Brussels Conference he had occasion to expose that fallacy, as he might show by reading an extract from his speech on that occasion. He had then pointed out that a distinguished member of the Conference had likened silver to "a sick man whose state was aggravated by the medicine which was given to him;" and this was not surprising, because he contended that the physicians were not merely mistaken in their treatment, but in the patient; that it was gold who was the sick man, not silver. He had long before publicly expressed the opinion that the purchase of silver under the Bland Act was opposed to the first principles of monetary science, and must, unless the true remedy were applied, end in disaster. He had pointed out to the Conference that the Government of India did not desire a rise in the value of silver, but stability; still, should that Conference break up without arriving at any definite result India would have to take immediate measures for her own protection. However, whether those measures would result in the stoppage of the silver coinage and the adoption of gold, he could not say, but that step would be fraught with immense evils, the result of which it was impossible to foresee, though the general feeling in India was that it would be disastrous to the gold-using countries rather than to India. He had also pointed out that the only true remedy was the adoption of the bimetallic system. He would now apply the clinical thermometer to supposed invalids by the aid of diagrams showing the fluctuations in the values of gold and silver respectively, as compared with commodities. These diagrams showed that since 1873 gold had appreciated between 30 and 40 per cent., whilst silver had kept at about the same level. What had they done in India? They had put the healthy man—silver—into bed with the sick man—gold—suffering from an infectious disease. One great disadvantage bimetallicists laboured under in these discussions was that they could not come to close quarters with their opponents. He was thankful to Sir Raymond West, not only for admitting the appreciation of gold, but for bringing forward a theory to account for it. He had said it arose from the enormous advance in commerce, and that a liking had sprung up for gold as the more convenient medium of exchange. The bimetallicists' theory, on the contrary, was that before 1873 gold and silver

were used jointly as international money, but after that year silver could no longer be used for the settlement of international balances, and, therefore, gold had to perform alone the functions of international purposes which had hitherto been performed by the two metals jointly. The result was an immense strain on gold, and its consequent appreciation. If Sir Raymond West's theory were right, the conditions which affected it would have been spread gradually over a considerable period, and the line in a diagram representing the fall of prices would have been tolerably straight. But the actual results were quite different and entirely in accord with the bimetalists' theory. For the 15 years preceding 1873 prices had risen considerably, and it was only after 1873, when the amount of money available was diminished by the demonetization of silver, that there was a great and sudden fall in prices. Mr. Giffen, who was the great exponent of the monometallist views of Sir Raymond West, after reading a paper before the Royal Statistical Society in 1879, impressed upon his hearers the following moral:—"The scarcity of gold which has contributed to the present fall of prices, and may have serious effects in future, should, if possible, be mitigated, and should at any rate not be aggravated by legislative action." And he added—"Any change tending to increase demand for the precious metal ought to be deprecated—still more, ought we to deprecate any change in the silver-using countries in the direction of substituting gold for any part of the silver in use. *It would be nothing short of calamitous to business if another demand for gold like the recent demands from Germany and the United States were now to spring up; even a much less demand would prove a rather serious affair before a very long time elapsed.*" Sir Louis Malet showed that the consequence of currency legislation had been that the gold-using States had been quadrupled as regards population, and trebled as regards foreign trade. Mr. Goschen had stated, with regard to the insufficiency of the gold reserves, that he could not exaggerate the danger to which this country was exposed, and the danger arising therefrom to the supremacy of British credit, and that we had escaped by the skin of our teeth a catastrophe which would have affected every branch of industry. He had said the attempt to get rid of silver might produce a crisis greater than the commercial world had ever seen, and that a campaign against silver would be disastrous even to those countries which were using gold. Mr. Gladstone, from the manner in which he treated the question when it came before Parliament, appeared not to have taken the trouble to have mastered the modern developments of the question. He had evidently confused the variation of gold from silver with the stability of gold, though the two things were utterly different. As Mr. Goschen pointed out, instead of gold having varied 3 per cent., as Mr. Gladstone stated, at the time of the Australian and Californian discoveries, it had varied 30 per cent. There was a most extraordinary

inconsistency in sanctioning this bastard system for India. India next asked for a reasonable automatic system which should regulate the currency by the law of supply and demand at the market price of the bullion, and this had been refused, but now they had sanctioned an abominable system of attempting to raise, artificially, the value of silver in a most mischievous manner. The Government of India could scarcely be blamed, as it was narrowed down to the choice of two evils, a policy of uncertain drifting to shipwreck, or a policy of despair. The Viceroy, in introducing the Bill, said they had borne long enough a state of things which was becoming more intolerable every year, and that they were bound, therefore, to make some attempt to place the finances on a more stable basis. The Viceroy admitted the many difficulties of the problem, and the uncertainties with which it was surrounded, and only offered this solution, not as perfect, but as the best which could be devised; but he added:—"We are too well aware of the risks attending such an experiment to take this momentous step with a light heart." So far as it has gone, the experiment has been a decided failure, and, even if success had been attained, at what expense would it have been achieved? Sir David Barbour said, should it be otherwise impracticable to maintain the price of the rupee at 1s. 4d., contraction would be necessary, which, if carried far enough, would restore the value of the coin. But all history showed that the contraction of the currency was about the most dangerous thing to undertake, and it was frequently attended with bankruptcy and ruin. How did India stand now as regards her currency? It was neither gold nor silver. It consisted of a huge silver token currency circulating at a nominal value above its market value as bullion, which was a fatal thing. It was unable, without immense loss, to use this coin for the settlement of external debts. As an Indian official he had seen and felt acutely the hardships which had been inflicted on that class, and also in his connection with the secretariat he had been painfully aware of the immense financial difficulties and struggles of the Government, but all these things sank into insignificance compared with the ruin which would fall upon India if they were successful in inflicting on her currency that forced elevation of the value of money, which Bentham, in his "Principles of the Civil Code," declared to be fraudulent bankruptcy.

Mr. R. L. EVERETT, M.P., said he had read with great interest Mr. Robertson's excellent and able paper, and fully agreed with what he said as to the supreme importance of this question. It had for years appeared to him that, as a financial issue, it was about the greatest the world had ever known. He must apologise for saying anything in such a meeting as this, for he was but a plain farmer, having no connection with India, but he had formed the opinion for some time that the cause which was afflicting agriculture all over the world was the same as that which had brought

such overwhelming difficulties on the Government of India. Agriculture was in distress in all parts of the world, as was amply confirmed by what passed in the House of Commons the previous evening, when the President of the Board of Trade, referring to the great distress in agriculture, said, to comfort the gentlemen who were complaining that nothing had been done for their relief, that an equal, if not greater, distressed condition of agriculture was found in other countries. He referred to the Australian Colonies, where wholesale bankruptcy and ruin to bankers and individuals had recently been seen; to the United States, where agriculture was depressed to the last degree; to Germany, to France, to Italy, in all of which countries agriculture was suffering. Some were trying to save themselves by protective duties, but he pointed out that thus far such measures had not saved agriculture from the calamities under which it was suffering. Now all those countries were gold-standard countries; they were all afflicted by the common curse, of a steadily appreciating currency. In India the troubles were those of the Government, as he understood, rather than of agriculture, which, on the whole, during recent years, had been fairly prosperous. But since the divorce of the two precious metals twenty years ago, and the extraordinary divergence which had developed since then between them, the distress of the Government of India had been growing more and more acute. As to the fact of this divergence between gold and silver, which, until twenty years ago, were linked together, there can be no possible dispute. The ordinary impression amongst the public was that it had all been caused by a fall in silver which was described as a depreciated metal, and one that was steadily losing its value. But those who would pay attention to the facts would see that this was a mistake; that the movement, as between the precious metals, was not a movement in silver at all, but in gold. As Sir Guilford Molesworth had truly said at the Brussels Conference, it was not silver which was sick, but gold, and the proof of that was very evident. You could not test a movement between two metals by measuring one by the other. If you measured silver by gold of course silver appeared to have fallen, but, on the contrary, if you measured gold by silver the value of gold had equally risen. You must have as a common measure something independent of either of the two, and the political economists said that "as money measured commodities so commodities measured money," and he knew of no way in which they could so accurately determine what had really occurred between the two precious metals as to take the index numbers which several authorities had compiled of the wholesale prices of the leading commodities, and apply those numbers to the two metals. If you applied those numbers to silver you found it was comparatively stable. Within a very little, the value it bore to commodities was the same now as it was 20 years ago. All through that time the movement had been

very slight; at one time the movement had been a little in the direction of the appreciation of silver, but in the last two or three years it had moved a little in the other direction; speaking broadly, silver had shown itself a stable measure of commodities. Applying the same measure to gold you found at once a movement steadily progressing, by which gold, year by year, rose higher and higher, and its purchasing power became greater and greater. As Lord Beaconsfield said in 1876, in the House of Lords, "Gold is appreciating every day, and as it appreciates the lower become prices." Every year which had passed since then confirmed the truth of that statement; facts showed that the movement was in the gold rather than in silver. This might be confirmed by looking at what was occurring around in daily life; everywhere in gold-standard countries there were complaints of low and failing prices and of unprofitable industry. The producer, whether agricultural or otherwise, exchanged his produce for gold, and year by year he found that, for no reason he could explain, he had to put up with less and less of it for his goods; and producers of all kinds, especially agricultural producers, were in increasing difficulties. Again, there were many people who, unfortunately for themselves, had entered into fixed engagements to pay gold every year on mortgages or long leases, and they now found, according to the refrain of the old song,—*"The mortgage swallows up all."* Year by year it took more produce to meet the interest they had to pay, and they were unable to pay off the mortgage, because their property was so depreciated. This depreciation of property was another effect of the same cause. If the standard by which objects were measured grew longer, of course there were fewer lengths of that standard. This shrinkage of income, and depreciation of property was seen on every hand in all gold-standard countries. Coming to the immediate question of the paper, the condition of India, it was perfectly simple. India was in the position of a mortgaged farm. She had the advantage as an agricultural country of a stable currency. During the last 20 years her agriculturists had enjoyed a fair measure of prosperity, but India as a nation was mortgaged to this country; it had incurred a great gold debt, the annual interest of which amounted to many millions of pounds, and not being a gold-producing country she had to meet that indebtedness with her products. As the value of gold had mounted up and up, she had to send larger and larger quantities of her produce to meet her obligations in this country. That was the cause of the troubles which India suffered from as a nation. As to the cause of the rise in the value of gold, if it were due to some natural cause it must be endured, but, on the contrary, it was due to legislation entirely, as could be traced step by step. When the divergence between the two metals first showed itself, the Government of the United States appointed a committee to inquire into the cause, and they reported that it was due to legislation in Europe. Soon after, in 1876, the British

House of Commons appointed a committee, over which Mr. Goschen presided, and the committee reported substantially to the same effect, viz., that the future of silver in comparison with gold depended entirely on the course of legislation in different countries which had in contemplation a change in standard, and that if they continued one after another to exchange silver for gold as their standard, there was no limit to the fall of silver in comparison with gold. From that time nation after nation had gone on in that very path; they had closed their mints partially if not wholly to silver; they had in many cases abolished it as full legal tender, and had thrown an enormously increased demand on the other precious metal, with the inevitable result that with the increased demand, with hardly any increased supply to meet it, its value was driven up by leaps and bounds. The difficulties of India, with her heavy mortgage to meet, compelled her to seek some remedy, but, as Sir Guilford Molesworth truly said, the medicine now applied, instead of being calculated to cure or abate the disease, was calculated to produce exactly the opposite effect. They struck another blow at silver, and opened a new door of demand for gold, two causes which, taken together, could have no influence except to further widen the divergence between the two. The direct effect was to drive up the gold higher, and so to increase the real weight of the burden resting on poor India. He believed that it would soon be recognised that a more gigantic blunder had never been made than in this matter of the Indian currency. He said so much in the House of Commons when the matter was discussed there last July. This measure appeared to him to have folly written across the face of it. India was in a fair state of prosperity with a rising revenue, but with her outgoings increasing still faster. They wanted more money, and how did they go to work to provide more? By closing the mints and stopping the supply which had hitherto freely come into the country from the mines. They wanted more money, and the course adopted was to shut off the hitherto free source of supply. Again, the trouble of India was connected with there being two moneys in the world. Up to 1873 there had been only one, till by legislation a divorce took place, and gold and silver became two separate moneys, each going its own road. This action now created a third kind of money, a contracted and protected rupee. Instead of simplifying matters and re-marrying what had been divorced and returning to one money, they carried the divorce, if possible, still farther, and made a third kind of money, and in doing so they had dislocated trade in all directions. The contraction of the currency which they were endeavouring to produce would, too, necessarily hurt producers, and would do so more and more as it proceeded. India had had a stable currency, and in its place they were now giving her a very unstable one. Inasmuch as this was done without consulting Parliament, the blunder, in his judgment, became a crime, for there were plenty of people in Parliament who

had thought a great deal about these matters, and could have given good counsel, but the Government rashly plunged into the muddle without giving the representatives of the people in this country the opportunity of saying anything. It was an axiom with the late Prime Minister, as well as with some of the other high functionaries of the State, that gold was fixed and constant in value, and that all the change which had occurred was in the silver, but that conclusion was entirely and completely contrary to the facts, and naturally a misunderstanding of the facts led to a wrong remedy being applied. It appeared to many people, and had appeared for years to the Indian Government, that there was only one real substantial remedy for this extraordinary state of things which had arisen, and that was not to shut the mints and contract the supply of money, but to open them wider and allow silver and gold both to be equally the one money of the Indian nation and of the world. The difficulties of the situation had increased tenfold since the meeting of the Conference at Brussels. Most devoutly did he hope that the result of such meetings as that to-day would be to open the eyes of those who had been blind, and to show the nation that by opening the mints to both metals, and allowing both to be legal tender without limit at a ratio fixed by mutual agreement, a happy solution of all these difficulties might be found.

Mr. R. BARCLAY CHAPMAN, C.S.I., said the text of the paper was the Indian currency, but its subject was really the disturbance of the monetary standard, of which the collapse of the gold-value of the rupee was only a superficial symptom. It was a remarkable illustration of the narrow limitations of the human intellect that, notwithstanding the pressing practical importance of a right solution of the problem, more than twenty years of discussion had brought economists and financiers no nearer to unanimity than they were at present. Mr. Chaplin, last Thursday, deprecated a dogmatic attitude towards the question in dispute; but, nevertheless, delivered his own clear judgment upon it with no uncertain sound. He should like to follow that example, and without attempting to prove each position afresh, state the fundamental conclusions which, in his judgment, had become more or less axiomatic, but, to save time, would pass on to the particular point under discussion. He would, therefore, offer a few remarks upon the recent deposition of silver from its function as the monetary standard of India; and he would say at the outset, that the authority exclusively responsible for the measure was not the Government of India, but Her Majesty's Government of Great Britain and Ireland. He did not understand the Chancellor of the Exchequer to disclaim this responsibility; but it was necessary that it should be clearly fastened upon him and taken off the shoulders both of the Government of India and of the Indian Currency Committee. The interests at stake were far too vast, and the consequences of error

far too momentous, for the devolution of the responsibility of Her Majesty's Government upon committee or proconsular authority. Moreover, it should be observed that not only was the possible remedy for disorder of the Indian finances quite beyond the power of the Government of India, but both that Government and the committee were even precluded from considering it. He declined to confine his criticisms by any such limitation. On the contrary, his first criticism must be that the preliminary rejection of the true and only remedy for the overwhelming financial difficulties of India vitiated, *ab initio*, the proceedings of the Government of India, and of the committee, and of Her Majesty's Government. Those proceedings were, accordingly, avowedly, empirical, and in the highest degree mischievous. The closure of the Indian mints was the greatest blow that could be struck at the value of silver. The silver interests of India were enormous, and right policy demanded that the value of silver should be carefully guarded and promoted. The action of her Majesty's Government went far, very far, towards its destruction. The interests of India imperatively demanded that the appreciation of gold should be stayed or reversed. The closure of the mints was certain indefinitely to accelerate it. The evil, rightly understood, could not be rectified by taxation; the measure taken was taxation of the most scourging, indiscriminate, and extravagantly wasteful character. Mr. Barr Robertson defended the measure as, however mischievous, sound in itself, and he feared that this admission might be misunderstood. Surely no currency was sound which was not directly, or indirectly, convertible into an intrinsic form of its nominal value. What was the present nominal value of the rupee? It had none. For the moment, it being the height of the export season, and the Council bills being enormously in arrears, the exchange ruled well above the intrinsic value of the rupee, but who had any confidence that this state of things would continue when these exceptional conditions subsided? Mr. Barr Robertson considered the present system sound because provision was made for the rupee not rising above a certain gold-value. It would surely be more to the purpose if provision were made for its not falling below the intended value. Till the currency was guarded on both sides the system must be stigmatised as wholly unsound. The Government of India feared the ship of State was sinking, and to save it, knocked the bottom out. So far his criticisms might have been used (as they were used) *a priori*, and now he would examine the measure *a posteriori*. Had it been successful or not? There was good reason for the statement that the mints were closed, not because any one individual concerned liked the expedient or had any sort of confidence in its effects; but, solely, in a despairing hope that insolvency might be averted by the arrest of the downward grade of the exchange at 1s. 4d. What had been the result? The exchange had collapsed. The net requirements of the home treasury of the Government of India this year

amounted to £18,700,000, and there was little or no expectation that more than £9,500,000 would be remitted from India before the close of the year. In other words, during the first nine months of this rash experiment £9,250,000 had been added to the terrible incubus of the gold debt of India. And who could look forward without the gravest apprehension? Even if the existing rate of exchange were maintained, at least Rs. 300,000,000 must be remitted to the India Office alone, year by year. Who was bold enough to stand up and say it could be done? The demoralisation of the Indian exchange was not the disorder itself, but only a symptom or index of the real disorder—most valuable if rightly interpreted, but fatal if we were so unskilful as to mistake the symptoms for the disease. The real disorder was the constant appreciation of gold, a disorder which the empirical treatment of the symptoms would inevitably aggravate. For this disorder there was only one possible remedy, viz., a return to the silver-gold standard, the comparative stability of which did not rest upon any mere theory which might be rejected, but upon the sure ground of the experience of ages, which could not be rejected. Mr. Chaplin said that this most urgent problem must be settled by those assembled in this room. Not so! it was far too great an issue to be disposed of by an academic discussion. It must be settled by the Government and people of this country, great now, but on which decadence was impending, if we still refused to grapple with the imminent and appalling danger which was now upon us. It was said that there was no evidence that other nations would co-operate with this country in the grave enterprise which they advocated. It would be time enough to consider this obstacle when Great Britain had approached them in vain. So far as he was a politician, he was a Liberal, but he thankfully recognised that the great Conservative party had shown a far more open mind on this question than the Liberals. He trusted that, when the Conservative party were next in power, they would recognise the supreme urgency of this problem, and allow no other political question whatever to take precedence of it, for the national life was at stake, and if there were much further delay in dealing with the insidious disorder which was sapping all our prosperity, it might be too late. He asked those gentlemen whom they had hitherto failed to carry with them to at length reconsider their position. All were agreed upon the existence of a great disorder. The only remedy yet suggested was upon the table; it was simple; its efficiency was proved by experience; and they had confidence in it; nevertheless, it was rejected—almost superciliously. What was the alternative? To do nothing but slide on, waiting, like Mr. Micawber, for something to turn up, had brought them far on the way to ruin.

Dr. CHARLES R. DRYSDALE desired to express his warm thanks to Mr. Barr Robertson for his elaborate paper on the Indian currency. In many things, he was

in agreement with the author of the paper. Thus, he took it as proved that there had been a great fall in gold prices, which had taken place since the year 1872, or thereabouts. The method made use of by those who showed that gold had greatly risen in purchasing power was quite unimpeachable, and he, therefore, took it for granted that 65 sovereigns would now purchase as many standard commodities as 100 sovereigns would do in 1872; also, he was persuaded that, as shown by Mr. Barr Robertson, silver had remained more constant in its purchasing power than gold. Doubtless, the fact of the appreciation of gold was to be accounted for by the great accession of international transactions that had taken place since 1872, which caused the supply of gold, even although it had been large, to fall far short of the demands of trade in those days of rapid ocean transit and scientific culture of new countries. Mr. Barr Robertson had rightly called attention to the evils caused by this appreciation of gold. All contracts made in 1872 to pay a certain fixed sum to annuitants, mortgages, or pensioners of the State, were now much more onerous than they were in 1872. But, on the other hand, all similar contracts made in 1850 were far more onerous than they were in 1872, and this might again occur. Commercial affairs, however, were not affected by this appreciation of gold, for wheat and iron would exchange just as easily for each other when gold was scarce as when it was plentiful, only in that case, as occurred at the present time, commodities exchanged for each other at lower prices—a matter of not the slightest consequence to merchants. He admitted then, fully, that the appreciation of gold was a great evil in the case of long contracts, such as those made with pensioners of the State; and in the case of burdens on real estate, for the benefit of younger children. But he was inclined to compare this monetary evil, which was caused by the appreciation of the standard of value, to any of the irremediable evils that afflicted the human race, such as cancer or earthquakes. We must occasionally make up our minds to accept the evils which accompany our best schemes. He believed that it was impossible for mankind to fix upon any standard of value which would vary less than gold; and, therefore, it was much wiser to accept the occasional inconveniences, which arose from a change from high to low prices, or *vice-versâ*, than to rush, like unskilled surgeons, to operations in hopeless cases. It was simply, he thought, because there were these inconveniences in a gold currency that so many able men had been tempted to look around for a remedy, and to propose what he considered an impossible solution of the difficulty, *i.e.*, the introduction of a double standard of value, gold and silver. It was perfectly clear to him that whenever the two metals were introduced into the currency of a country all debtors would at once begin to pay their debts in the cheaper of the two metals. For instance, if A had borrowed £100 some years ago, he would,

when the time of repayment came round, be only too glad (unless, as was done in the Argentine Republic, the contract specially stated that the debt must be paid in gold) to pay his debt in silver, which would cost him far less labour and capital to procure for that purpose. The consequence of this would be that a commercial crisis would soon supervene, as had last year occurred in the United States, in consequence of the views of the bimetallists having been carried out to a great extent in that country, when the heresies of protection, and other fallacies in political economy, were still so prevalent. Dr. Drysdale quoted from a speech of Sir George Warrender, referring to the financial panic in the United States, which he said was caused "by the fear of a large portion of the population that if the United States went on coining silver at the rate of \$4,000,000 a month, the day was not far distant when silver, in place of gold, would be the basis of payment."

Mr. HERBERT GIBBS said he was glad to have heard a speech from a gold monometallist, because they were getting rarer and rarer. He had quoted Sir George Warrender as one who opposed the Sherman Act, but it was not necessary for anyone to defend the Sherman Act, especially as he understood Dr. Drysdale not to insist that it was a bimetallic provision, though he thought it had something to do with bimetalism. The Sherman Act, of course, had nothing whatever to do with bimetalism. The whole principle of bimetalism was that the mints should be open to the free coinage of both metals, and the Sherman Act lacked that feature. He further said that if bimetalism was introduced, debtors would at once proceed to use the cheaper metal to pay the debts in. He (Mr. Gibbs) did not exactly know what was meant by the cheaper metal. Of course, the whole argument of the bimetalists was that debtors would use either metal as it suited them, and the contention was that the demand so set up, which was enormously greater than any other possible demand there could be for either metal, would regulate the value of those two metals. Dr. Drysdale also said that, even if they had bimetalism, it would be impossible to avoid a rise in the value of money, and there he was rather inclined to agree with him, and say that even bimetalism was not perfect, but they had not to compare bimetalism with any ideal system of currency, but with one which, in the words of Mr. Arthur Balfour, was the worst form of currency which could have been devised by man, where the standard was continually fluctuating. Of course, they could not control the production of the precious metal, but they could control the demand. The demand for separate systems of currency would be reduced, and they would no longer be subject to violent fluctuations in value, such as were caused by Germany changing its currency, and throwing an enormously increased demand upon

gold. With regard to Mr. Robertson's paper, he confessed that questions like the appreciation of gold seemed to be of much greater practical importance than the main subject of the paper, which was whether it was advisable to re-open the Indian mints now they were closed. That seemed to be merely a comparison of two disadvantages, and he agreed with Sir David Barbour that whether successful or not, it would, in each case, entail very great disadvantages to the rest of the world, especially to England. The great practical value of such a paper and discussion was that it explained to a certain extent the quantity theory of money, and also brought into high relief this dangerous appreciation of gold. It showed very well that though the Indian Government could contract the currency, and though by that means if India continued to prosper the rupee must go up to a certain extent in value, it did not at all follow because it went up in the value of commodities that it would go up in the value of gold. The Sherman Act was another case in point. Many people thought it had failed entirely, but he did not think it had. It failed to raise the gold value of silver, but it did maintain the value of silver as measured by commodities, and, as far as he could calculate, it had counteracted the action of the German Government, leaving the increase of production to keep up the value of commodities. It was not a question whether the Indian Government succeeded in raising the value of the rupee. That did not touch the evil from which India and the rest of the world suffered, which was the appreciation of gold. If silver had really appreciated, except for the political difficulty of raising taxation, it would not matter to India; her taxation would be increased in rupees, but, as measured by commodities, it would remain the same; the international trade was carried on by commodities, and not by gold or by silver, India had to pay us in commodities; all these debts were paid in commodities. Mr. Everett had used the expression that "India had incurred a gold debt;" of course, that was quite true, but it was not quite all the truth. England had made India incur a gold debt, and that point ought not to be lost sight of. India was a conquered country, she had been made to incur a gold debt of £100,000,000 sterling to England, and England had, by precept and example, encouraged other nations to exercise a demand for gold and appreciate the value of that gold debt, and had so increased the indebtedness of India. This was a very important matter. When native agitators talked about tribute they probably did not understand what they were talking about, but when they came to see what England had done in the way of increasing the gold indebtedness of India through her action with regard to currency, he thought some of the charges brought against England were not altogether unfair. In the *Times*, recently, Mr. Playfair, not a native agitator, but a man occupying a high position as a member of the Legislative Council, said that in his opinion the interests of

India were being sacrificed to those of Manchester and Lombard-street. That was a very grave charge to make, and one which ought to be answered. He would not say anything about Manchester as regards the exclusion of dues, firstly, because there was only one opinion about it; and, secondly, because if the interests of India were being sacrificed to Lombard-street, those of Manchester, and not only of Manchester, but of the whole trading population of this country, were being sacrificed to Lombard-street, and that meant to a very small fraction of the English community, and a comparatively very unimportant fraction of English trade. People often said, "Why do you talk about India, other countries are the same?" That was quite true, Australia and our own colonies were exactly in the same condition as regards their indebtedness and the appreciation of gold. All other people who owed money were in exactly the same position. The question really was, not between silver and gold-using countries, but between creditor and debtor countries, and the question which occurred to him was, was it right of England to advance commodities as she had done, because she did not advance gold to her debtors; she advanced commodities and registered the commodities in gold—was it right to legislate so as to raise the value of that gold, and so cause her debtors to repay her in a greater amount of commodities than she had advanced? He did not like introducing moral questions into such a discussion, and he would therefore say—Was it sensible to do it; was it wise to harass one's debtors; did it not lead to repudiation in numerous instances? The question really seemed to be not so much whether the Indian Government should retrace its steps and cease to contract the currency of India, but whether the British Government should not retrace its steps in seeking to contract the currency of this country.

The CHAIRMAN said there were many able gentlemen present who had dealt with the matter theoretically and practically, as far as science was concerned, but he should like to call attention, for a few minutes, to another aspect of the matter, namely, from the point of view of the natives of India. There could be no question in the mind of anyone who had listened to the argument, that the essence of the well-being of India was silver, and the policy of the Government of India had been, not to make more silver available to India, but less. Those who had been in India knew that what induced the cultivator to take in jungle land and bring it under cultivation was the silver which he was able to get for his produce over and above what he wanted for his domestic requirements, and the moment the supply of silver to the agriculturist was curtailed, the slower would be the development of the country. The agricultural prosperity of India was undoubtedly the mainstay of the Government, and he could hardly imagine anything more impolitic.

than the action recently taken to curtail the supply of silver. Most of those who thought on the subject, even as far back as June, felt that the policy of artificially raising the rupee to 1s. 4d. could not be successfully carried out without an import duty on silver, though he quite admitted that had it been carried into effect it would have only aggravated the injury. The imports of bar silver into India, in the past eight months, had been greater than in any corresponding period before. The use to which this bar silver was put was open to various theories, but it appeared to be the fact that the importation was entirely on native account. The astute Marwarri, finding a difference of from 18 to 30 per cent. between the bullion and the so-called rupee, bought the bar silver and conveyed it up country, and persuaded the ignorant ryot, who had always regarded bar silver as being of equal value in weight to rupees, as it could always be coined on a small seignorage, to exchange his hoarded rupees for this silver, allowing him probably some slight premium, but taking the principal part of the advantage himself. It might be said that this sort of thing would come to an end in time, but he did not think it would, as India had absorbed in this way already over nine crores of rupees since the mints closed, and the demand had by no means ceased; orders were coming to-day for more bar silver to be sent out, in spite of the 5 per cent. duty. What would the natives of India, who had always looked on the Government as the incarnation of everything just and righteous, say when they found out that this bar silver was not worth what they supposed, when they took up these hoards of bar silver in time of distress, and found they could not convert it into anything like the equivalent number of rupees? They would put it all down to the Government. It seemed to him they were perpetrating a fraud, and a colossal injustice not, as Mr. Robertson said, on other countries, but upon our own people in India. He did not hold himself up as an authority, but he thought there were possibly other alternative schemes to tide over what everybody admitted was a very pressing difficulty. The Indian Government had merely adopted this as a makeshift, and he thought they might have effected it in many other ways which, if time had permitted, he would have gone into. What they had been now compelled to do had been to put a duty upon all imports going into India, and there was no doubt this course was open to them before they closed the mint and perpetrated this injustice. He believed himself, as they had heard from Mr. Gibbs, that India having to pay her gold debt in exports, a swinging import duty on imports would have encouraged exports, and would have enabled her for a time to keep out of her difficulties. No doubt this savoured rather of Protection, but he should prefer to call it Preservation, and he had always been taught to regard self-preservation as the first law of nature. Any method short of that recommended by Mr.

Robertson and others would be but a temporary makeshift, and one fraught with future evil, even if it brought about apparent present good.

Mr. LESLEY PROBYN said it was a matter of regret to him that these questions had not been discussed in a more practical manner. They had had a very interesting discussion on bimetallism, but the question was the present monetary position of India, and whatever could be done with it. In some points he was not generally in agreement with Mr. Robertson, but in one he was entirely, and that was with what he said with regard to this experiment never having had a fair trial. He happened to have in his possession the written opinion of two gentlemen of the highest eminence, one known all over the world as an economist and monometallist, and the other equally well known as one of the leading bimetallicists. One said, "I think the Indian Government must be crazy" (this was with reference to what they did after the closing of the mints); "never was an experiment critical enough in itself so botched by financial folly." The other gentleman said, "The Indian Council has made a shocking mess of this measure; the veriest tyro in monetary matters would have managed things better; it has been a succession of blunders." He entirely endorsed those opinions, and he said that until the measure had had a fair trial it was nonsense to say that it had failed. Mr. Chapman made a mistake in leading them to believe that the rupee was now lower than it was when the mints were closed. It was then 1s. 2½d., and now it was a little bit lower, but very little, so that the measure had given a certain amount of stability. No one who had studied the questions, except those in Calcutta who sent the hysterical telegrams urging the Secretary of State not to sell bills under 1s. 3¼d., dreamt that the rupee would jump up to 1s. 4d. The members of the committee never thought it. True, two or three days after the scheme came out there was a great speculation in rupee paper which sent it up to 1s. 4d., but everyone knew that that was not a permanent rise. He did not know what induced the Indian Council to act as they did. It looked to him, to use a sporting expression, very much as if they were riding for a fall, and if they had gone on riding in the same way, by the end of next June there was no doubt they would have come a most tremendous cropper. They had only saved themselves by adopting the sensible course of selling their bills for what they were worth.

Mr. BARR ROBERTSON said some of the points raised by Sir Raymond West had already been dealt with, but he laid down one cardinal proposition, which he (the speaker) entirely disputed, viz., that it was impossible to counteract the effect of the different costs of production of gold and silver. There was a sort of common sense air about that which made it look as if it might be true, but on a little examination it would be seen that it was quite practicable to tie the two metals together, and this had been recom-

mended as likely in a great degree to alleviate the present misfortunes into which gold countries had fallen. Sir Raymond West argued as if the two metals were totally distinct, and were worked each on its own basis, and as if it was quite immaterial whether one was adopted by a dozen countries and the other by half a dozen or *vice versa*. His contention was that there was not enough gold and silver in the world to maintain the level of prices of 1873, or any thing approaching it. That being so, and it being, therefore, impossible to obtain a gold standard with anything like stability, the question was, was there not some method by which these two metals, as old as the history of the world in their use as money, could be brought together, and by which they could escape from what Sir Raymond West held to be a necessity of the situation. The way proposed was to adopt a ratio between the two metals. He would not go into the question of what that ratio should be, or whether it could be carried out immediately to its full extent; he was only dealing with the question of principle, and the principle was this—The leading Governments of Europe and America should adopt a ratio at which they would mint gold and silver, the coins thus minted being legal tender to any amount. Suppose there were in England to-day £100,000,000 sterling in gold, and £20,000,000 in silver, if such a course were adopted, the same amount of business could be carried on with £60,000,000 of gold and £60,000,000 of silver, or with 70 gold and 50 silver, or with 50 gold and 70 silver. The cardinal point about the use of the two metals was that they would be applied to the same use as money, and be equally legal tender. Sir Raymond West supposed a case where they were applied to a totally different use, one in a limited number of countries only, and the other being scrambled for all over the world. Dr. Drysdale thought people would pay in the cheaper metal; but there could be no cheaper metal, because if the miner in the mountains of Mexico knew what the bar silver would fetch when it reached the Bank of England, and could calculate the freight and charges upon it, he would know exactly what price he ought to get for it. There would be no cheaper metal, and no uncertainty, any more than there was with regard to bar gold. The cardinal point was that the two metals were applied to the same uses, and if the leading Governments agreed that they should be coined at the ratio of 20 to 1 or 24 to 1, or whatever they pleased, they had the power to cause those coins to pass current, and to be received at their full value. Dr. Drysdale came forward with an objection which, he thought, was exploded when the Gold and Silver Commission, half of whom were friendly to bimetalism and half hostile, came to the conclusion that for 200 years, ending in 1873, the gold and silver standard was maintained in Europe without a deviation of more than 3 per cent. above or below the legal ratio of $15\frac{1}{2}$ to 1. With such an historical fact as that, it

was hardly worth arguing the question further; but he would say, however, that the United States, France, Belgium, Holland, Italy, and Spain, were, to-day, waiting to adopt this gold and silver standard. It was no mere theory in the hands of an obscure faction trying to struggle into notoriety. These great Governments, the Presidents of the American and French Republics, the Dutch, and others were all endeavouring to enforce the point that there was no risk whatever in adopting the gold and silver standard. It was really too late to argue on this question, and he only did so out of courtesy to the gentleman who raised it, for, in his opinion, it had passed beyond any possibility of doubt. He had been taken to task by several of the speakers on the question of Indian currency; of course, the details of this question were very numerous, and, from their point of view, they were perfectly right, but he had confined himself to a limited view of the subject, and this, perhaps, had led to the idea that he was putting forward a proposal which was open to the gravest objection. They were dealing with two things—currency principles, some of which could be attained, but those they wanted most they had not been able to attain: and they were also dealing with a question of practical policy. Some of the arguments advanced dealt with the question of principle; what would be the best method to adopt, not in the existing circumstances, but on the principles of currency? He began his paper by saying that the Indian Government were refused bimetalism; and they then insisted that they could not take the risk of the United States abandoning the purchase clauses of the Sherman Act. The British Government prohibited them, in a sense, from adopting the only method which they held would be of any real use, and consequently, while he perfectly agreed that they ought to have had bimetalism, he should not blame them for trying to protect themselves by any other method. The Indian Government assumed that the United States would abandon the purchase clauses, but he held they would not have done so, and, therefore, the Indian Government adopted a policy before it was necessary, and which might never have been necessary. He thought, therefore, they made a mistake, but that was not the question they were considering. They had made a mistake; they were in a changed position, and the question was, were they to add on a series of further mistakes in the hope of getting back to a more satisfactory position? Sir G. Molesworth had spoken of this as an abominable attempt to raise the gold value of the rupee, but the fact was the Indian Government took the attitude that they had certain payments to make in London in gold, and they said, "If the British Government continue requiring us to pay more and more rupees for every £100 we owe, there is a point beyond which we refuse to keep our mints open; we may be willing to accept

1s. 2d. as the price of the rupee, but we will not take 1s. That was the position, and it was a perfectly intelligible issue. To-day the rupee was intrinsically worth about 11d., but the limited rupee was worth 1s. 2d. That was an illustration of the quantity theory of money. They were blaming the British Government for the contraction of the currency in England because it produced lower prices, but when Sir G. Molesworth and others said that contraction of currency was always an evil, he must join issue with them. Contraction was an injury when it went on lowering prices, but was it an evil when prices were being inflated far beyond their former level? The Indian Government might have fairly contended that whereas in 20 years—1874-93—the average of the India Office index numbers was 92, in the last year it was 104, or 12 per cent. above the level; and though they might have been blamed for contracting with prices at 92, it was quite different when they were at 104. The prosperity of the last 20 years had been coincident with a price of 92 for a given quantity of produce; but 12 months ago the price was 104, and what was going to happen if the Indian Government had continued minting, and if, as they believed, the United States had abolished the purchase clauses of the Sherman Act. This 104 might have gone to a much higher point. In London silver prices on January 1, 1893, were 107, but on January 1, 1894, they had risen to 129, the Indian mints being closed, and the purchase clauses of the Sherman Act repealed. This was a practical question. The principle was perfectly clear, but in certain circumstances practical entirely overbore theoretical considerations. He could not agree, therefore, that the contraction of the currency in this case would bring bankruptcy and ruin, as it had done in England. He would not deal with the enormous mistake of not selling the Council Bills; but one thing the Indian Government had succeeded in, and that was in forcing the British Government and people to consider that there were gigantic blunders in process of accomplishment under their auspices. What had happened since the suspension of the purchase clauses of the Sherman Act? In Mr. Sauerbeck's table it appeared that English gold prices had fallen 6 per cent. from 1889 to 1893, but he also showed that in the last two months these articles had fallen 3 per cent. further. This was six per cent. in four years, notwithstanding all the gold which was flowing in. If it did flow in, it was not nearly enough, for here was the fact that in the last two months there was a fall of 3 per cent. as against a fall of 6 per cent. in four years. The consequence was the position was getting more aggravated in every direction. The closing of the mints had forced the attention of merchants, bankers, and others to these questions, and to-day in the city, and throughout the country there was an amount of attention being paid to this matter, such as had not been seen before during the present century. It was a question of policy,

which followed what he regarded as the true principle of currency. Of course, it would be better to have bimetallism at a fixed ratio, and free mintage but if you had a currency which was rapidly increasing, the contraction of it was not on principle to be specially deprecated. If you had a certain range of prices produced by a certain quantity of money, and if that quantity were increased by 30 or 40 per cent. he could not condemn a policy which pronounced in that case in favour of contraction; it was not a policy of bankruptcy and ruin, as was caused by the contracted gold currency of this country. At that late hour it was perhaps not wise to say anything more. He did not know that he differed much from most of the gentlemen present, except in the fact that he looked at the matter from a different point of view. Mr. Barclay Chapman spoke as if the Indian Government had control of all the conditions, and, consequently, he argued on the question of principle merely. But his point was that the Indian Government had to do the best they could for themselves; and on the question of closing the mints, it was now unnecessary to argue. They had to judge of their own case, and as they had to send to England an increasing number of rupees, which they could not afford, and as bankruptcy was approaching, they were warranted in saying—We must stop this at any cost. They were often met with the argument, that under bimetallism there would be enormous amounts of silver, but in the paper he read a year ago, he showed that whereas silver prices had remained comparatively stationary, gold had gone up, and, consequently, gold prices had fallen. This was proved by the diagram shown by Sir Guilford Molesworth. In order to bring prices back to the level of 1873, it would require an addition of £400,000,000 or £500,000,000 sterling, which was far more than all the gold-producing countries of the world could furnish; it was simply impossible. He would only say, in conclusion, that in this question, as Mr. Chaplin had remarked, England alone blocked the way; and it was for those who believed that this was the case, to use all their efforts to induce the British Government to follow the example of the other civilised countries of the world, who were anxious to alleviate the present financial, commercial, and industrial distress.

The CHAIRMAN then proposed a hearty vote of thanks to Mr. Barr Robertson, which was carried unanimously, and the meeting adjourned.

Mr. HYDE CLARKE writes:—In order to meet the real main points in Mr. Barr Robertson's paper it is necessary to put his assertions on one side and to take up the issues raised by him which affect the vital questions. This I shall do briefly. Thus Mr. Barr Robertson and his supporters incriminate the administrators of India here and in that region for

not having prevented the fall of silver, for having caused the fall of silver, and for having thereby caused enormous losses to the population of India on 300,000,000 of silver ornaments. They call on the governors to stop the fall of silver, and to compensate for the fearful losses imagined by themselves. These are serious charges with which to feed the hostile agitations by which the populations of India are now being dangerously excited. Did the Government cause the fall of silver, and can they arrest it in the future? If not, these charges should be withdrawn, and the people should not be deluded and deceived by them. Sir Raymond West came to the point in referring to the change of prices as being due to economical and commercial causes throughout the world, and consequently to causes not within governmental choice or direction. This argument, which is founded on solid facts, affects the feasibility of the Government becoming responsible for the bimetallic nostrum in the future. The revolution in prices is not caused by silver nor by gold, but is the result of the great changes in the production and transport of commodities, effected by the remarkable inventions brought into action, and notably the cheap steel processes of Bessemer and Siemens. These effects have not received due attention from economists, statesmen, and financiers here, and still less in India. Transport has been reduced by cheap railway lines and steel steamers and engines throughout the world, and the prices of commodities have fallen without the intervention of any ministry in England or India. On the contrary, they could not avoid the operation nor its consequences, which also affected silver mining in particular. Silver has been produced more abundantly and more economically. No international compact nor legislative arrangement can restore silver as a precious metal under any bimetallic contrivance, not even with the influence of the United States. So far from any such expedients being effective, they cannot prevent silver from being produced cheaper still, and any artificial premium created will encourage its more abundant production, as it did in the States, but will not give it a permanently higher price. With regard to gold, its position as a factor does not depend, as alleged, on its greater or less annual supply. Gold being a material of more permanence, it is the whole stock existing in the world which has to be regarded, and its sufficiency present or future for currency depends upon the extent to which it can be economised by banking arrangements. The demand for gold in England and in the great centres of the United States has of late years been thus economised, and the tendency is to further economy by the extension of modern banking to France, Germany, and the more advanced countries, and thereby to a diminished, and not to an increased demand for gold, as affirmed by bimetallists. As India comes more and more under the influences affecting the world at large, and as exceptional conditions and practices disappear, prices will be assimilated there, and gold currency

will regulate them, and to that India will infallibly come. The administrators and political agitators cannot prevent this. The like influences will dominate in China and Japan, and silver will cease to govern. These are more important considerations than the temporary measures which the governors of India, during a transition period, are compelled to adopt, and than the compensation for the fall in value of a metal permanently depreciated, and for the stock of ornaments which the holders, rich and poor, will not bring into the market under the fluctuations of the bullion markets.

Mr. MARTIN WOOD writes:—There not having been time, even at the adjourned discussion on Mr. Barr Robertson paper, permit me in this manner to raise a question that has scarcely been adverted to by any of the speakers, though it is just touched upon, and that skilfully, in the paper itself, that is, how far are the present difficulties of our Indian Government responsible to currency or exchange, and how far do they arise out of the political-financial conditions under which that dependency is held and constituted? Mr. Herbert Gibb came near to this in his remarks as to the gold debt of India having grown up under the cognisance and control of the British Government; but in speaking of interest on that debt as “several millions” (the sterling interest is only about $2\frac{1}{2}$ millions), he attributed undue significance to this portion of the home charges; by far the larger proportion of these inexorable demands consist of current charges quite other than interest. England not only does not contribute a single pound, but allows our spending departments to pile them higher year by year. It is the more necessary to refer to this branch of the subject seeing that during the whole of the Loan Bill debate in both Houses of Parliament there were only two distinct references to their political-financial part of the subject which underlies the whole question of “loss by exchange.” The frankness that permits reference to this central point of the whole Indian monetary question is so rare, that it is highly desirable to refer to two speeches—one was in the Peers, the other in the Commons. The Marquis of Salisbury, after mildly supporting the suggestion as to the duty of the British Government to enter into negotiations with other nations towards agreeing on a ratio between the two metals, added—“The other suggestion is of a simple character, and that is, whether it would not be better, instead of the Indian Government borrowing £10,000,000 here, that the English Government should [itself] borrow £10,000,000 I do not say that any right is established, but there is some claim to consideration on the part of a country whose position and greatness, and convenience, and whose interests, to a certain extent, are permanently affected by this very extraordinary state of things. If we take the risk of an increase in the silver debt, instead of throwing it upon the already overburdened shoulders

of the Indian Government, we should be performing an act of generosity, almost deserving the name of *an act of justice*, and should earn much gratitude and recognition from the Indian people." In course of the previous debate in the Lower House, Sir Donald Macfarlane, had spoken with similar courage. The balance of trade in favour of India is only a figure of speech; it only represents the India Office's obligatory demands on the dependent country, and only in form corresponds to that phrase as properly used in city editors' articles as applied to other countries. Mr. Robertson's practical demonstration on this *crux* of the whole subject [p. 368] is the counterpart of J. S. Mill's abstract synthetical statement of the principle fifty years ago, and which Walter Bagehot expressed in more popular form in 1877. When this naked truth comes to be realised, it will clear off half the misdirected discussions that have obscured this special branch of Imperial finance, compared with which the currency controversy is little more than the surface symptom.

INDIAN SECTION.

Monday, March 19, 1893; Sir JAMES KITSON, Bart., M.P., in the chair.

The paper read was "Indian Railway Extension: its relation of the Trade of India and of the United Kingdom."

The paper, with the discussion, will be printed in next week's *Journal*.

Miscellaneous.

THE DEVELOPMENT OF THE TRADE IN TROPICAL FRUITS.

The subject of the importation into this country of tropical fruits has occupied a considerable amount of attention for many years past, and more particularly since the period of the Indian and Colonial Exhibition, in 1886, and, notwithstanding that a good deal has been done in this direction by bringing freshly-gathered fruits in fast-going steamers, the variety has not yet become very great, and there are numerous products of the tropics the flavour of which is totally unknown to the ordinary English palate.

There are, no doubt, difficulties in the way of bringing these products of far off climes to our shores in a proper condition, under which they would recommend themselves for consumption in the English market, but there are many fruits that might be well preserved in syrup, in a similar manner to that which is now so successfully accomplished with the pineapple from China, Singapore,

and the Bahamas. Some fruits especially lend themselves to this kind of treatment, having little or no flavour to recommend them in their fresh state, but when treated with syrup or candied with sugar the flavour is developed or increased to such an extent that the fruit becomes much more valuable. As an instance of this may be mentioned the fruits of the rose apple or jambosa (*Engenia jambos*), a small tree of India, but cultivated in many tropical countries, where it is planted for hedges, for the purpose of giving shade and for ornament, as well as for the sake of the fruits, which have a rose-like fragrance, with usually but very little taste. These fruits, though called rose apples, would more properly be called rose pears, as they are more or less pear-shaped, but they vary very much in size and colour, some being white, while others are rose-pink. They are produced in very great abundance, and in many countries are a waste product, the insipid taste of the fresh fruit being no recommendation to them. Preserved, however, in sugar or syrup, and formed into "candied rose apples," they become quite a tasty fruit, though they have never appeared in the English market. Closely allied as they are to the guava (*Psidium guajava*), we might expect them to be of some value, for these latter fruits are not unknown to us, being sliced and bottled in syrup, as well as preserved in tins and sold under the name of Geneva cheese. There seems no reason then why the rose apple should not become an article of commerce in this country if it were preserved in syrup, or crystalised guavas might likewise be utilised to a much greater extent than they are. Indeed, throughout the whole range of tropical fruits which the stay-at-home Englishman does not get a chance of tasting, there is a wide field for experiment. Mangoes (*Mangifera indica*), in their numerous varieties, litchis (*Nephelium litchi*), longans (*Nephelium longanum*), rambutans (*Nephelium lappaceum*), and a host of others might be mentioned which are common enough in their own countries, and which we sometimes see here, but only in small quantities, and, for the most part, too expensive for general use.

Whatever the mango may be in its fresh state—and opinions are very much divided upon it by those who are qualified to speak from having eaten the fruits in their own countries—it is certain that preserved in syrup, as we sometimes see it in this country, it is tasty and a good addition to our rather limited course of dessert fruits in the winter season; besides this the mango can be converted into an excellent jelly, and when we are told by the superintendent of the Botanical Department in Jamaica, in a bulletin issued from that department, that "tons of the fruit of the common mango are wasted every year," a justification seems to exist for bringing this subject prominently forward, and for the benefit of those who have the opportunity to try the experiment, and who may have the materials at hand, the recipe given in the bulletin before mentioned is here reproduced. "Pare and boil the mangoes, and when

the pulp is soft, take it from the seeds and press it through a brass or copper wire sieve (iron wire spoils the colour) with a wooden spoon, weigh the pulp, and with an equal quantity of white sugar boil until it jellies, then pour or ladle into bottles or jars. The fruit must be frequently stirred during the first, and constantly during the second, process. The pulp should be thick after it comes through the sieve, if not, it must be reduced by more boiling before the sugar is added. The mangoes are better green, but they should be perfectly full; a little lime juice can be used, if desired, for flavouring."

The aril, or fleshy portion of the litchi, which, in its fresh and ripe state, is such a delicious morsel, could scarcely be treated in this fashion, but after the shell has been removed, and the stone taken out, the fleshy portion could be placed in tins and soldered down, as is done successfully with pines; and there is no doubt that so treated there would be a large European demand for them. The longan and rambutan might be preserved in the same way, though it is possible they would not meet with the same favour as the litchi. Among species of *Passiflora*, there are several well-known fruit-producers, natives of the West Indies and the neighbouring South American continent, which, like the rose apple, would probably be improved by preserving in the manner already referred to; the same may be said of the fruits of the naseberry, or sapodilla plum (*Achras sapota*), a native of tropical America, but now cultivated in other parts of the tropical world for its excellent fruit, which, when dead ripe, has somewhat the taste of a medlar. The Japanese kaki, or date plum (*Diospyros kaki*), is another fruit having some botanical affinities to the last, and, like it, must be fully ripe before it is fit for eating. A large number of varieties of the kaki are cultivated both in China and Japan, and when preserved in sugar, as is done by the Japanese, they are much valued. They are also eaten fresh, or dried in the sun.

All these fruits just referred to are comparatively well known to travellers, but there are others not so well known that have equal, or even stronger points, to recommend them, such, for instance, as the Kei apple, the fruit of a shrub, native of the Cape of Good Hope and Kaffirland. It is a fleshy, globular fruit, about the size of a walnut, and is much used by the natives when fresh, on account of its agreeable acid taste; it is also used as a pickle, and, when ripe, made into a really good preserve. Another South African fruit, which has been described as the best native fruit of the country, is the amatungula (*Carissa grandiflora*); they vary in size, from that of a large olive to a small round plum; they have a reddish colour at first, but change as they ripen to a dark violet hue. The flavour is an agreeable sub-acid, and they make excellent preserves, which are much valued in Natal, where the fruit is known as the Natal plum.

These thoughts concerning new sources of fruit

supplies in the winter season, when fresh fruits are practically unattainable, are brought to mind more vividly by the exposition, in the shops and markets of London and other large towns, of delicacies, in the shape of preserved and crystallised fruits, which are, for the most, the French exports. When we see the fleshy fruits of the almond, the small cumquats, chinois, apricots, pears, cherries, and even the common chestnut, which, in its fresh state, is so indigestible, treated in the way they are, it is surprising that something has not been done to extend the list, and develop the resources which are ready for use.

SUGAR PLANTING IN REUNION.

Consul Bennett, of Réunion, says, in his last report, that the principal product of the island, formerly called Bourbon Island, is the sugar-cane, and this being a plant which quickly exhausts the soil, a system of rotation of crops has been adopted. On lands worked by hand-labour the following method of cultivation is adopted. The land is cleared of all weeds and bush about a month before the planting, the weeds being carried away or burnt. The furrows are then made and kept as far as possible at right angles to the slope of the ground, so as to enable the plants to keep the soil from slipping down the hill. In the rainy part of the island a space of 5 feet is left between the lines of cane, and 4 feet to 4 feet 6 inches in places where vegetation is less active; the object in the latter case being to spread a cover over the ground as quickly as possible to retain all the moisture received. When the furrow is finished, it is holed for the reception of the plant. In each hole, two, three, or four cane cuttings, each with three or four eyes, are placed in parallel lines. If manure is used, a little is placed below the cane shoots and above it, and firmly stamped down. The fields are generally cleaned five or six times before the cane arrives at maturity, but as the plant grows larger and less subject to attacks from insects, the weeds are generally shaken to remove loose earth, and left on the field. If the lands are worked by ploughs driven by oxen, the following system is adopted:—The bean plants which immediately precede the cane crop are buried by ploughing them up. The plough is drawn by six Madagascar oxen, one man guides it, there is a boy to prod the oxen, and one or two men follow to place the bean plants in the furrow. Fifteen days afterwards it is again ploughed over, harrowed once or twice, and lightly rolled. The horizontal furrows are then made with the plough and deepened by hand labour when the ploughing is done, the cane shoots as usual being placed end to end in two parallel rows at the ordinary distances in the furrow. The principal canes grown at Réunion are the Port Mackay, La Louziers, and the Quingamp or Batavia, all of which are well known. The richness of the cane varies

according to locality and species. The density of the juice varies from 1·075 to 1·090, and even 1·095, the temperature being reduced to 4° Centigrade. In an ordinary season the mean richness may be placed at 14·50 kilogrammes of sugar to 100 kilogrammes of cane, 0·75 kilogrammes of glucose, and 0·35 kilogrammes of ash. In certain favoured regions where it rains little, the mean richness may be put at 15½ to 16 per cent. The product per hectare naturally varies; as a rule it is from 30,000 to 35,000 kilogrammes of cane to the hectare, including young canes and re-shoots, and on well cultivated properties from 45,000 to 50,000 kilogrammes of cane per hectare may be produced.

Correspondence.

REFRIGERATING APPARATUS.

Mr. L. STERNE writes:—In the discussion on Prof. Linde's recent paper on refrigerating apparatus, a desire was expressed for information regarding the De La Vergne system of refrigerating by means of ammonia compression; thus the following short description may not be without interest. The general features consist—in common with all ammonia compression methods—of an apparatus for compressing and liquifying anhydrous ammonia gas; and one for allowing the resultant liquid to re-expand into gaseous form in such a manner that the heat necessary to accomplish this result may be most readily drawn from the substance to be cooled—the whole forming a closed cycle. Compression is effected by a double-acting vertical compressor, or compressors, actuated by steam or other suitable motive power. The special feature of this is the means whereby the whole charge of ammonia is discharged at each stroke, there being absolutely no loss by the re-expansion of gas compressed into the clearance space. This most important result is obtained by injecting into the compressor, during the compression of each charge, a definite amount of a special oil which is unaffected by ammonia; and by an arrangement of valves, ensuring that both on the up and down stroke the whole of the gas is first discharged, then a small quantity of the oil—the remainder being left to fill the clearance space. This oil also most effectually seals the suction and discharge valves, and prevents any leakage past the piston-rod gland; while, at the same time, it lubricates the compressor in the most complete and efficient manner. The additional and important advantage is also obtained of carrying away with the discharged oil a considerable portion of the heat of compression, thus rendering unnecessary a water-jacket, or any other means of keeping the compressor cool. The compressed gas, together with the discharged oil, passes from the compressor into a separating tank, whence the gas is led to a special condenser to be liquified, and the oil to a series of

cooling pipes, where the heat of compression is removed, it then returning to the oil injector to resume its cycle of operations. The ammonia condenser is a feature of interest, and is of the open-air type, arranged so that the cooling water trickles in a thin film over the surface of the pipes containing the hot gas, thus allowing a considerable amount of surface evaporation to take place, and giving a greatly enhanced cooling effect. By this means the least possible amount of cooling water is required, and in special cases, where a good air circulation can be obtained, cooling water may be entirely dispensed with. The liquid ammonia, as it forms, passes to an ammonia storage tank, and thence to a second separating tank, where any trace of oil that may by any means have passed over to the condenser is removed. From this it is led to the expansion cock, which separates the compression side of the plant from the expansion or cooling side, and regulates the supply of ammonia to the expansion coils. The expansion system is arranged to meet the requirements of each particular adaptation, and for such a purpose as cooling a chamber for chilling or storing meat, consists of a sufficient amount of wrought-iron piping arranged round the walls or on the ceiling, and provided with radiating discs at short intervals. These discs very greatly assist in the rapid transfer of heat from the chamber to the pipes. If desired, the expansion pipes may be placed in a battery, and air, mechanically circulated, is passed from the chamber to be cooled through this battery, and returned after giving up its heat. This method of cooling direct by means of expansion piping, without the intervention of brine or any other medium, is quite peculiar to the De La Vergne system, and is obviously the most economical and direct method of obtaining the desired transference of heat. It is only rendered possible by the most perfect arrangement of jointing and fitting up, whereby any leakage or loss of ammonia in working is entirely guarded against. That the desired degree of perfection has been obtained by this system is proved by the many hundreds of miles of direct expansion piping which have continuously worked for years with the most satisfactory results.

General Notes.

ORIENTAL CONGRESS.—The tenth session of the International Congress of Orientalists will be held at Geneva, from the 3rd to the 12th September next, under the presidency of Professor Edouard Naville. The Congress will consist of the following sections:— I. India and Aryan languages. II. Semitic languages. III. Arabia, Turkish and Persian languages. IV. Egypt and African languages. V. The Extreme East. VI. Greece and the East. VII. Oriental Geography and Ethnography.

Journal of the Society of Arts.

No. 2,158. VOL. XLII.

FRIDAY, MARCH 30, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Proceedings of the Society.

INDIAN SECTION.

Monday, March 19, 1893; Sir JAMES KITSON, Bart., M.P., in the chair.

The paper read was—

RAILWAY EXTENSION IN INDIA, AND ITS RELATION TO THE TRADE OF INDIA AND OF THE UNITED KINGDOM.

By JOSEPH WALTON
(Of Middlesbrough).

An important deputation lately waited upon the Secretary of State for India to impress upon him the importance of the extension of railways in India and Burma. It was then stated by a delegate from Blackburn that they could send goods stamped, baled and packed, value say 6s., from Blackburn to Moulmein or Rangoon—a distance of nearly 8,000 miles—for 6d. per piece; while from Moulmein to Zimmé, the capital of the Shan States, and a distance of 300 miles only, the carriage on pack mules cost 7s. 6d. per piece. This high cost of transit closes to our goods the South-Western States of China, where a population of 100,000,000 of well-disposed and industrious people is waiting to receive them.

A more significant introduction to the subject of the paper I now have the honour of laying before you I could not desire. Let me premise, however, that I am well aware this is no new subject, and also that I do not appear here to-night as in any sense a railway expert; but, having strong views as to the importance of the opening up and development of our Eastern Empire—in the interests not only of India, but of the trade and commerce of the United Kingdom—I spent six months in travelling through a considerable portion of India and Burma, with the special object of gaining from men upon the spot, who best know the needs of their respective districts, information in regard to railway extensions, and the probable effects of these on the commerce and other interests of the country. I was indebted

to Government officials and railway engineers in London for such letters of introduction to India as enabled me to have access to reliable information. This paper will, therefore, merely convey, in a very imperfect form I fear, what I thus gathered; and where in the course of the argument I may cite familiar facts, I ask your indulgence.

The need of India for considerable additions to her railway system, is implied by the fact that while about one-tenth of the total capital of the world, or one-fourth of the invested capital—that is to say, five to six thousand millions—three times the amount of all the gold, silver and paper money in existence—is invested in railways, only about £200,000,000 has been spent on railways in India. The necessity is more than confirmed by a comparison with the United States of America, as the following Table will show:—

	Area.	Population (about).	Population to square mile (about).	Railway mileage (about).
India	1,553,925	287,000,000	185	18,042
U.S.A. ..	2,935,000	62,000,000	21	170,000

In other words, India possesses only one mile of railway to every 15,900 inhabitants; America, a mile to every 365—that is, a country with little over one-fifth the population has nearly ten times the mileage of India. In the United States of America the amount expended on railways per head of population has been £32 4s.; in India 14s. Again, in one year (1887), the United States of America built 13,080 miles; to make the same length India required 40 years. In addition, the existing railways are so distributed, that over a large area of the country hardly the fringe of the population has yet been brought under their influence. The fact that there are fertile districts of great extent without any railway facilities whatever further emphasises this.

The Bombay Chamber of Commerce, in its report for 1892, points out that, “though enormous tracts of country are unprovided with the means of transport, and existing lines show a large and increasing profit, the Government will neither make the lines nor permit anyone else to do so, and years are passed in mere correspondence leading to no result.” It was stated to the Parliamentary Commission, 1884, that India required 50,000 to 60,000 miles of railway at least, before the country could be considered as at all adequately supplied.

General Strachey and Sir C. Bernard agree that the saving to the people of India, effected by the railways already introduced, is not less than £40,000,000 sterling annually, so that a sum equal to the amount Government has lost on railway account (including military and famine lines) in 30 years is saved to the people every year. Besides this, it is a fact that Indian railways pay better than most others. In 1887-8 the net earnings were 5·2 per cent.—over 1 per cent. more than the earnings of railways in the United Kingdom, 2 per cent. more than the United States of America, and 2 per cent. more than the world's average.

In 1891, the average profit, including commercial, military, and famine lines, was 5·76 per cent.; in 1892, 5·43 per cent. Were it not that the State has, unfortunately, to pay on the guaranteed lines what are now excessive rates of interest—viz., 4·8 per cent. sterling, or 8·2 per cent. rupee revenue, whereas it could now borrow at 3 per cent. or under—instead of showing a deficit, the railways of India would show a handsome surplus, in spite of the great fall in the value of the rupee in exchange for gold. The military and famine lines naturally show a considerable loss; but the former being essential for the defence of the Empire, and the latter saving, as they do, an enormous sum which the Government would otherwise have to spend in direct relief, this loss should not be allowed to retard the construction of such further military and famine lines as may be necessary; nor the laying down of urgently-needed commercial lines, which would speedily show a profit. The railways in an Empire like India, with an annual increase of population of about 3,000,000, are certain to give better results year by year. As many present know, the natives of India delight in railway travelling, and the trains are almost invariably crowded to overflowing, the number of passengers carried in 1891 being 121,931,461, and, in 1892, 127,465,913.

The unsettled condition of the currency question has been latterly the greatest hindrance to the extension of railways. At the same time the difficulty has been exaggerated, and the present affords probably a better opportunity for pushing ahead with the making of railways than any previous period, inasmuch as they can be built more cheaply. The average cost of existing lines was about £13,000 per mile, whilst metre gauge lines could now be built for £3,000 to £5,000 per mile. For, (1) at the present value of the

rupee, gold has considerably more purchasing power in India than when the exchange was 2s.; (2) all kinds of permanent way materials and rolling-stock are now extremely cheap; (3) formerly two or three contractors divided all this work: now the competition is very great, and contracts can be arranged on much more favourable terms; (4) the facilities for transporting European material from England and across India are greater and the cost less than ever before.

The *Pioneer*, on the 14th of June last, assumed railway expenditure to be on an average one-third in England, and two-thirds in India; but even assuming that it was for new extensions, one half in each country, and bearing in mind the fact that the purchasing power of the rupee in India is practically what it was when a sovereign was worth only ten rupees, we see that the appreciation of sterling in India exactly balances the depreciation of the rupee in England.

Again, if the exchange value of the rupee for gold were to fall even further, would it not, by stimulating Indian exports, and by causing existing and new railways to serve a larger area of the country, result in such an augmentation of traffic as would provide without difficulty the increased number of rupees that would have to be remitted to this country to meet the sterling obligations?

In 1877, Lord Northbrook said:—"No one could doubt that the expenditure on the Indian railways was one of the most profitable investments that ever was made by a great nation."

Lord Lytton said:—"In the Indian railways the Government of India possesses a vast and annually growing property, an expanding source of revenue not derived from taxation, which exists in no other country; and to me it is as clear as the sun in heaven, that the financial prosperity of India will, in future, depend mainly on the development of her railways and canals. People ask what would happen if the opium revenue were to fail. I reply, cover the country with railways, and neither the loss of the opium revenue, nor anything else need seriously disconcert us."

From a military standpoint more lines are necessary, and would effect an enormous saving in the cost of transport. In the Afghan-campaign, 1878-80, a single railway train did with comparative ease in sixteen hours what it would have taken 2,500 camels to do in a fortnight. Fifty to sixty thousand miles of railway are required in India. Appended are particulars of over 10,000 miles of proposed

railways, particulars which I obtained from railway engineers, the heads of the Public Works Department of the Government of India, and other authorities. In addition, there are many much-needed feeder lines, which could be constructed at a relatively low cost. The *raison d'être* of this paper is to urge the immediate construction of this instalment of 10,000 miles. The completion of such a work would confer extraordinary benefits on India and the United Kingdom alike.

The Government of India has lately issued fresh terms on which they are prepared to consider offers for the construction, by the agency of private companies, of branch lines or extensions of existing railways to be worked, when constructed, by the main line administrations. The principal concessions offered are — (1) The free use of land; (2) the provision of rolling stock, and the maintenance and working of the new lines at favourable rates by the main line administrations; (3) the free use of surveys, &c., made at State expense; (4) the carriage of stores and materials over State lines at favourable rates; (5) the grant of a limited rebate from the earnings of the main lines towards ensuring the proprietors of the new lines a dividend of 4 per cent. per annum on the approved capital expenditure. And, in addition, if it can be legally arranged (at present it is not legal), authority will be given to charge to the capital account of the branch railway during construction, and, until the close of the half-year next following the half-year in which the branch railway may be fully opened for traffic, such sum as, together with any net receipts from working, will suffice to pay interest at the rate of 4 per cent. per annum on the paid-up capital.

This is a step in the right direction. There are, however, many feeder lines that would not pay in themselves, even after they were credited with the limited rebate from main line earnings proposed to be given, but the earnings of which, taken in conjunction with the extra revenue accruing to the main trunk lines from the additional traffic brought to them by the new feeder lines, would make their construction desirable. Apparently, it would be necessary either that more liberal terms should be offered, or that the Government should construct the lines without delay. The very fact that the Government reserves the right subsequently to take over these lines on easy terms, shows that it is considered desirable to possess them; besides, the Government can raise the required capital on better terms than any private

company, and would have but little additional expenditure for engineers and other members of their large staff, who have not at the present time sufficient employment, but who have nevertheless to be paid. Some among them who are still full of energy and experience, would rather remain employed in India a few years longer than be compelled to retire on their pensions. At the same time, in larger undertakings, where the disadvantageous conditions would not be so great, it would be wise to encourage private enterprise, by granting more liberal conditions, as well as reasonable guarantees, in order to render possible the raising of the money on favourable terms. So long as the Imperial Government does not deal effectually with the currency question, it cannot expect capital to be readily obtained unless there is some guarantee on their part of interest in sterling.

With the building of railways should be associated the construction of irrigation works. Those of India are the most extensive in the world, and give, on the whole, extremely good results, the average (excluding two or three comparatively useless works constructed years ago) being about 5 per cent. Irrigation is carefully studied in all the presidencies, while Rajputana contains in the tank of Dhebar the largest reservoir in the world, covering an area of 21 square miles. Some of the latest works are on the Chenab river, and irrigate over 4,000 square miles. Further works should be constructed on the Indus, which would probably irrigate 10,000 square miles. The whole 14,000 square miles dealt with by these two schemes have hitherto yielded practically no agricultural produce, but, with irrigation, would be amongst the richest, and certainly the cheapest, wheat-producing districts in the world.

Lord Kimberley, replying to a recent deputation, said he was "most anxious to have extensions of railways in India, and to foster trade with that country, but that the financial pressure was too great for them to do as they would wish." But is the position so very unsatisfactory after all? We have convincing proof of the prosperity of India in the fact that she has absorbed in recent years immense quantities of the precious metals—not less than 90,000,000 to 100,000,000 in a decade. It must be borne in mind, moreover, that unlike the national debt of this country, the permanent debt of India is represented by valuable revenue: producing assets, including railways, irrigation works, and land revenues, worth more in the aggregate than the total amount of indebtedness.

In the debate on the Indian Budget, on the 22nd September, it was estimated by the Under Secretary of State that the 1893-4 deficit would be Rx. 1,600,000. Owing, however, to the further fall in exchange, and including certain deficiencies of recent years, it now seems likely that the actual deficit will be Rx. 3,500,000. Taking into consideration the increased expenditure in various departments, the large amount that has been spent out of revenue on revenue-producing works, and the increased loss by exchange over the last ten years of nearly Rx. 7,000,000 annually—it would not have been surprising had the deficit been much larger. Mr. George Russell also said :—"The opening up of railway communication he considered to be the most hopeful and satisfactory of all the works of public utility in which the Government of India and private enterprise could be engaged."

Provision was made in the 1893-4 budget for the expenditure on new railways of only about 4,000,000 of tens of rupees, which will not pay for the making of more than say 500 miles. At the same rate of progress it will take twenty years to lay down the 10,000 miles which all authorities agree are required at once, and 4½ years to construct even the 2,200 miles already sanctioned.

Even accepting for a moment Lord Kimberley's view of the financial position, it seems clear that a *laissez faire* policy is not the way to improve it. If the revenues of the country are to expand, the country must be developed. Even if a considerable loss resulted for some years in connection with the working of the additional railways, the benefits, in the long run, would much more than recoup the State for previous deficits. An enterprising policy in the development of India is the only sound policy, and it is discreditable to a wealthy nation like England that the necessary funds should not be forthcoming. A high official in India, who wrote me the other day regarding the question of railway extension, and the development of the country generally, very pertinently remarked that "India is regarded by the Imperial Government as a milch cow, but they do not see that it is their business to give her fodder." The fodder that she needs is the expenditure of money to develop her resources, which would not fail to render her still more productive.

It seems that Republics and Governments of doubtful solvency all over the world may have the millions waiting in this country for investment merely by applying for them,

whilst India is to be starved. I wish that more of the pride that makes a Yankee back his "city" down to his last dollar could be infused into Englishmen in regard to the world-wide empire, the responsibility of governing and developing which is theirs.

While we are practically standing still, a comparatively poor country like Russia does not hesitate to raise £16,000,000 sterling to extend her railways in Asia, and even Turkey is building railways as fast as India.

There is but one opinion, both among railway men and Government officials in India, as to the great need for large extensions of railways in India and Burma, for the development of those countries, and for the mutual advantage of the Indian Empire and of the United Kingdom. What, then, ought to be done? The difficulties are almost wholly financial. One way of overcoming them, which, both from a commercial and a military standpoint, the Imperial Government would be justified in adopting, is to supplement what the Indian Government is able to do by issuing, say, £50,000,000 sterling of Consols at £2 15s. to 1903, and then at £2 10s. (which over thirty years would mean an average of £2 11s. 6d. per cent.), or terminable annuities of 99 years at 3 per cent. or under; and expend this in the making of, say, 10,000 miles of railway in India and Burma. In reply to a similar suggestion, Lord Kimberley stated lately, "as Secretary of State for India, I should welcome with joy all the money which you think proper to pour into our coffers for the making of railways in India." In endorsement of this policy, a resolution was adopted, with practical unanimity, at the last annual meeting of the Chambers of Commerce of the United Kingdom, held at Plymouth. Similar resolutions have been passed by various chambers of commerce in industrial centres, and confirmed by large public meetings held under their auspices, and mainly attended by working men. Possibly a simpler plan would be that the Imperial Government should back the Government of India's paper. In other words the Government of India cannot borrow so cheaply as the Imperial Government. But if the latter guaranteed this loan for the former, the money could be raised at the same rate as that at which the Imperial Government can borrow, say at 2½ per cent., or thereabouts.

As proposed by the Manchester Chamber of Commerce a short time ago, efforts should also be made to obtain as much capital as possible

in India. The Banks of Bengal and Bombay during the last two years lent large sums of money at the low rate of interest of $2\frac{1}{2}$ per cent.

At present the Banks in India are getting much higher rates, but the suggestion is one which ought to be acted on whenever the conditions of the money markets are favourable.

But why should the Imperial Government thus pledge its credit to borrow money for the extension of Indian railways? In the first place India is an integral portion of the British Empire. We have taken upon ourselves the task of guiding the destinies of the 287,000,000 it contains, and we must not shirk the responsibility. Secondly, the Imperial Government is largely responsible for the present position of Indian finances by reason of its neglect to introduce a gold currency throughout the British Empire when Germany, Austria, and Italy demonetized silver. It also failed to seize the opportunities that arose of acquiring the Dalhousie lines in 1875-80, causing a loss of many millions sterling to the Indian Exchequer. Thirdly, the mutual benefit to Great Britain and India of the expenditure wholly borne by the Indian Exchequer for military purposes is undoubted.

India suffers from a great injustice in having so many British troops quartered upon her. She supports about one-third of our regular army, and under the short-service system one-third of our army reserves are being created at the expense of India, thus saving the Imperial Exchequer. The *Times* of the 24th March last, said "India has been called upon to make great sacrifices in order to raise the fighting power to a standard required, not for her isolated defence, but imposed by her partnership in the imperial responsibilities of England." The armies of Great Britain and India are, in fact, becoming one vast organisation for the purposes of imperial defence; and neither the fall in the rupee, nor bad crops, nor scarcities approaching to famine, nor the strain of annexing the new Burmese provinces, has been permitted in India to interfere with the duty of placing that country in a position to discharge her share of the joint liability." Indeed, the expenditure for military purposes has been steadily on the increase during past years, and is likely to go on increasing. On July 3 last, the Duke of Argyll—commenting on the unsatisfactory condition of Indian finances—maintained that it arose through India being compelled to pay excessive tribute for the British Army. The Earl of Northbrook hoped the Indian Secretary would say what steps were being taken to

remedy the injustice recognised by all his predecessors and left for him to put an end to. The Earl of Kimberley did not differ greatly from the views of the previous speakers, and though Lord Salisbury and the Duke of Argyll had not succeeded in persuading their colleagues and the Treasury, he would continue to press the point whenever he found a convenient opportunity. Lord Roberts said he entirely agreed with the Duke of Argyll and Lord Northbrook, and trusted the point referred to would be settled before the preparation of the next Indian Budget.

Its duty as the paramount power, its neglect to solve the currency problem when the solution was easy, the undue share of Imperial military burdens borne by India are, then, so many reasons why the Imperial Government should render her substantial assistance now. Any doubt, however, will vanish when we consider the most important reason of all—the value of our trade with India—our actual and potential commercial relations. It is a pity that the advantages we derive from the possession of India are, most of them, indirect, but though indirect, they are none the less important. Already the value of our exports is considerable, but open the country thoroughly by railways, and there is no perceptible limit to their increase. For with every disposition to buy from us the expenditure per head of population in India on our manufactured goods is only about 2s. 6d. India is already our best customer, and whilst we had diminished exports to every other country last year, we had to India £1,000,000 sterling increase. Further, we are becoming yearly more dependent on foreign countries for our wheat. Whereas in 1863 England grew 19,500,000 quarters, in 1893 she produced only 6,000,000. America, on whom we greatly rely, is using more and more for her own consumption, and will have less to export. India, however, supplied with her complement of railways and irrigation works could produce all we need. Now a heavy crop is often almost a calamity to the owner, for a distance of more than 40 miles from a railway means that it must be wasted. While in exchange for her wheat India takes our manufactures, ships that bring wheat from America often go there in ballast. In addition, America not only shuts out our goods by protective tariffs, but, by her reciprocity arrangements with the republics of South America, is making inroads upon our trade there.

I have already alluded to our great trade interests in Burma and adjoining provinces of

South-West China, where 100,000,000 of people are waiting the advent of railways to enable them to buy British goods. The commercial men of this country, I may remark in passing, should lose no opportunity of representing to the Government the importance of vigilantly guarding our trade interests in the regions around Siam, and taking whatever steps may be necessary to prevent such territorial alterations as would be likely to hinder our tapping by railways from Burma, by the best routes, the trade of the great and populous South-West States of China.

As a manufacturing nation we are producing more and more every year. Concurrently, foreign markets are becoming more and more difficult to enter. It is not merely an advantage to us that the markets of our Eastern possessions should be developed: it is indispensable to our existence as a great manufacturing nation. Can a policy of inertia then be anything but disastrous?

Moreover, there is little doubt but that the railways proposed would prove remunerative, while the effect on the prosperity of India and England of building 10,000 miles of railway would be incalculable. As Sir E. Watkin says, "The refusal to extend Indian railways on the credit of the State is simply the refusal of a large profit on the investment itself, and a denial to the whole people of India of the far larger profit that that investment would create and distribute."

I must now bring these statements to a close. We have seen, by comparing her with other countries, and by illustrations, that progress in India is arrested for want of railways. Large and fertile districts are without railway facilities, crops are wasted, and our manufactures are excluded from valuable markets. Quoting various authorities in support of this contention, I have specially urged the construction of 10,000 miles regarded as imperatively necessary. The obstacles in the way being summed up in the currency difficulty, I have argued that they are exaggerated, and that, in any case, it is the duty of the State to

overcome them. The present being a favourable time for making railways, the Government, which is in India truly paternal, and, therefore, discouraging to private enterprise, should either make them or facilitate the work by giving reasonable guarantees. Further advocating the borrowing by the Imperial Government of £50,000,000 to build new railways, or the backing of Indian paper, I have endeavoured to justify such a policy by our duty to India, as part of our Empire; by our neglect to seize the favourable opportunity to settle the currency question; by the unduly large sum contributed by India to Imperial expenditure; and, most important of all, by the necessity of maintaining and enlarging our mutual relations of trade.

One word in conclusion. It is believed throughout Russia that England derives fabulous wealth from India. As to that I say nothing. It might, however, be useful to imagine what our feelings would be were India in the possession of another country. The Indian possessions of France were at the outset much more important than ours, and a Frenchman discovered the way to conquer India. Suppose that events had taken another course, and that this "brightest jewel of the British Crown" was now in the hands of France, would not the latter be an object of envy to us? What sacrifices should we not feel prepared to make had we possession of India? It remains then for us to do this now. No more mutually beneficial mode of discharging our just obligations towards India can be found than the one I venture to urge, viz., the raising of money on Imperial credit for the rapid development of the railway systems of India and Burma. Let us not be deterred by parsimonious considerations that can only result to our own detriment as to India's, but, by a more enterprising policy of railway building, throw open this really rich and productive country, possessing resources practically inexhaustible, giving her an outlet for her produce, and ourselves a needed and invaluable market for our goods.

NEW RAILWAYS PROPOSED TO BE CONSTRUCTED IN INDIA.

Railways.	Approximate mileage.	Remarks.
Kurrachee-Delhi	720	Some authorities say this route possesses advantages over any other.
(Or) Delhi-Bhatinda-Bahawalpur	390	Reduces distance Delhi-Kurrachee by over 230 miles, viz., to 937 miles. Opens out new country; no great engineering difficulties.

Railways.	Approximate mileage.	Remarks.
(With) Khairpur-Kotri (chord).....	172	
(Or) Kotri-Jhansi	770	
With branches :—		
(a) Point 80 miles west of Jhansi-Bina ..	80	These branches are required in any case; <i>b</i> and <i>c</i> establish direct communication between Bombay and Quetta.
(b) Barmer-Sukkur.....	200	
(c) Barmer-Deesa	140	
(Or) Patan-Sukkur	360	
Rutlam-Bhopal	150	Bhopal-Ujjain (100 miles) now sanctioned.
Godhra-Baroda (or Vishvamitri-Khakria)....	60	
Surat-Jalgaon (or Bhusaval) <i>viâ</i> Tapti valley; with branch, Manmad-Amalner	290	G.I.P.R. authorised to survey Manmad-Jalgaon. B.B. & C.I.R. authorised to survey Surat-Amalner.
Rutlam-Delhi, <i>viâ</i> Jaharapatam, Kotah and Kerowli	400	Large corn-growing district around Jaharapatam and Kotah; when crops good, are wasted for want of transport.
With branches as under :—		
(a) Chumbal-Jeypore	100	
(b) Kerowli-Dholpur	65	Fertile country; at Bhurtpore, <i>viâ</i> Kerowli, joins Rajputana State, Malwa section of B.B. & C.I.R.
Wadhwan-Kurrachee (military line)	300	Reduces distance Bombay-Kurrachee from 2,100 to 700 miles.
Umarkot-Sabarmati <i>viâ</i> Deesa, Palanpur, Uher- sala	284	
(Or) Petlad-Jungshahi <i>viâ</i> Wadwhan.....	380	
Sabarmati-Dholera	78	
Rutlam-Muttra <i>viâ</i> Bhurtpore.....	400	
Agra-Delhi (direct line).....	121	
Allahabad-Fyzabad.....	100	Fertile country north of Allahabad. Line likely to pay.
Wazirabad-Multan	240	This line will pass through a district of over 4,000 square miles; producing nothing practically at present, but which will grow almost anything when the Chenab River Irrigation Works are completed.
Kashmir (Abbottabad route).....	200	Now being surveyed. The connection of Kashmir with existing railways in India is urgently necessary for the proper development of the former; also for military purposes.
Ghaziabad - Moradabad	84	Gurmukhatzar pilgrim traffic.
Cuttack-Calcutta <i>viâ</i> Midnapur.....	358	These lines would complete a system directly connecting Madras and Calcutta. They pass through a rich country supporting a dense population. Encounter the Mahanadi, Godaverum, and Kistna deltas, which supply surplus food. Between Madras and Bezvada the Singareni coal-fields are tapped. This portion of the line passes through a less rich but fairly fertile district. It should be connected with a line passing through Gherria, Palamow, and Daltonganj coal-fields.
(With branches) Midnapur-Sini).....	100	
(And) Madras-Bezvada, with branch to Guntur	285	
Moghul Sarai-Gherria-Purulia, <i>viâ</i> Koel valley, to Daltonganj, Palamow, & Gherria coal-fields	304	The Gherria and Ranegunge coal-fields give the most remarkable show of coal I have ever seen, not excepting either America or England. I inspected in the nullah of one stream, in a distance of two miles, outcrops of 12 or 13 seams of coal, of a total thickness of 170 to 180 feet; and in another place I saw a coal quarry with excellent coal of a thickness of over 100 feet.
Also Daltonganj to Ghya	31	
Sambalpur-Cuttack.....	211	Would carry large pilgrim traffic, Pooree and Jaganath. Route reported as opening excellent country. Likely to give good results.

Railways.	Approximate mileage.	Remarks.
Raipur-Vizagapatam, with branch to Sireneha	556	Government say proposal in regard to Raipur-Dhurnai seems a promising one. Jeypore timber; fairly fertile country; large wheat and rice districts, brought into connection with Nizam's lines and East Coast; can also grow Indian corn and other grains on same land for own use in same year.
Warora-Warangol	180	Warora coal-fields. Fairly fertile country, well cultivated. Would probably be made by Nizam, who is also surveying another line—Aurangabad-Warangol.
Chitor-Oodeypore	70	
Mysore-Kadur (<i>viâ</i> Hassan) chord line	100	
Kadur-Bellary	120	Would open large country now without a railway.
Mysore to coast (two lines)—		
(1.) Arsikere-Hassan-Mangalore, and branch Hassan-Yedator	135	Through coffee and spice district.
(2.) Mysore-Telicherry	142	
With branch to Cannanore	12	
Birur-Shemoga	38	Survey completed. Will bring much betel nut and coffee traffic to main lines.
Bezvada-Masulipatam	50	
Palghat-Dindigul	108	
(Or, with detour) Opiliputty-Dharapuram—Odumallacutta	140	Taps Dindigul tobacco; Coffee-producing districts; Pollachi timber centre with enormous forests; populous; would carry pilgrims to Madura, <i>viâ</i> Dindigul; detour to Dharapuram considered most important; if Opiliputty line made only 70 miles of direct route <i>viâ</i> Pilni required, and former not wanted if Palghat-Dindigul made in full.
Nanjangud-Gudalur	54	Gudalur is in Wynard coffee district.
Nanjangud-Erode (Junc. So. I. and Madras Railway)	100	Direct route Madras-Mysore; saves journey round by Jalarpet Junction; mountainous, but if impracticable easier route by skirting Erode river to Gudalur.
Salem Iron District-Porto Nuovo	120	Charcoal furnaces once at P. N. but failed when rupee was 2s.; at present value might pay.
(With detour) Chuma Salem-Tiru Koilur	55	
Calicut-Cannanore	50	Dense population; fertile district; good rainfall.
Shoranur (or Patamba) Cochin and Quilon <i>viâ</i> Trichur	140	Meets South Indian Railway and opens up well-populated native states of Travancore and Cochin; good rainfall.
Madura-Pamben (with canal through narrow and extensive projection at Pamben)	92	Fertile, irrigated by river Vygah; line in connection should be carried across to Ceylon.
Tinnevely into Travancore, <i>viâ</i> Shencotta and Quilon	141	Passes through districts producing coffee and spices; good rainfall; Quilon one of the best ports on the coast; expensive, however, and passes some distance through uncultivated, mountainous, and sparsely populated land.
Point East of Quilon-Nagarcoil-Tinnevely <i>viâ</i> Trivandrum	200	
Hubli-Karwar	109	
Nanjangud-Calicut	155	

Minor Lines.

Railways.	Approximate Mileage.	Railways.	Approximate Mileage.
Trichinopoly or Tanjore-Puducotta.....	35	Zhob Valley Railway	267
Benares-Rae Bareilly	131	Patan-Harij	20
Ludhiana-Ferozepore	76	Mandvi-Bhuj (Cutch)	40
Fazilka-Okara with branch to Minchinabad	70	Nusseerabad-Kekri	35
Jullundur-Hoshiapur	26	Sultanpur-Bogra (E.B. State Railway) ..	24
Bahawalpur-Bikanir	136	Extension Dacca Section-Jamalpur	33
Khanpur-Mithun Kote	21	Ranaghat-Santipore-Bhugwangola	92
Kalka-Simla	60	Palamow-Baroon	61
Aonla-Soron <i>via</i> Budaon	40	Bhagulpur-Bowee	30
Luckeeserai-Gya-Palamow	163	Assam-Behar Railway, Kaunia-Dhubri section	54
Mugra-Cutwa	50	Companyganj-Fenchuganj	33
*Singhia-Madaripur	92	Nowgong-Nagode-Sutna	113
Sangor-Katni	118	Oude and Rohilkund R. Moorabad-Ramnagar Section	47
Akoli-Hingoli	56	Dehra-Dun	35
Gahara-Monghye-Khagaria	34	Rawal Pindi-Murree	46
Gonda-Balrampur-Ootrowlia-Tulsipur ..	41	Broach-Jambusar	31
Umballa-Patiala	26	Barsi Road Station-Pandharpur	33
Extension Mumbra (G.I.P.R.)-Nagothna (Kolaba district)	50	Bojok-Kadonbaw	36
†Ahmedabad-Prantij-Ahmednagar	47		

* Connects Bengal Central Railway and Assam Bengal Railway.

† Traffic would give most favourable results.

BURMA.

Railways.	Approximate mileage.	Remarks.
Prome-Chittagong, <i>via</i> Mimbua.....	400	These are alternative routes for connecting India and Burma, the first-named being probably the best.
(Or) Chittagong-Akyab-Minhla	420	
(With branch) Akyab-Yotarok	30	
(Or) Pokoko-(in connection with Myingyan Branch on opposite side)-Tammu, <i>via</i> Kanhla, Pauk, Gangaw, and Kalengo.....	352	
Mandalay-Kunlon Ferry on River Salween ..	285	Much needed. Would cross high plateau capable of cultivation, and is on direct road to Yunnan.
(And) Mandalay-Akyab	250	Urgently needed—likely to pay.
Bassein-Henzada	86	
Extension of Meiktila and Meiktila-road line to Myingyan	60	
Mogaung-Minmaw, or Myitkyina	40	Considerable Chinese trade would concentrate on Minmaw if railway made.
Moulmein-Zimmé-Kiang Tung	450	Would gain for us the trade of Central Indo-China, as well as South-West China, and open up rich Mekong Valley. China only imposes 5 per cent. <i>ad valorem</i> duty.
Moulmein or Rangoon-Ssumao	550	
Kale Valley		Teak forests worked by Bombay Burma Company. Railway would be incentive to industry and increase trade. Inestimable for military purposes. Troops Pokoko-Gungaw, occupy now 12 days; railway would reduce time to 12 hours.

CEYLON.

Anuradhapooru-Jaffna (extension of Polgahawewa-Kurunegala)	200	If irrigation works accompanied railway extension (from Kalawewa Tanks) Tamils could be got over, the country settled, and line would pay.
Galle-Matara	20	Cocoon trade—cocoonuts, oil, coir for ropes, &c.
Colombo-Chilaw	50	Populous, fertile district. Much needed, and would certainly pay.

DISCUSSION.

The CHAIRMAN said he looked at this subject from the point of view of a practical manufacturer who had an eye to new markets. In the course of a political campaign in which he was engaged two years ago, he had occasion to speak to the manufacturing communities in Lancashire and Yorkshire, and he found that this question of Indian railways and markets was almost as interesting to them as that of Home Rule and Parish Councils, and consequently he was asked to deliver an address on the subject at Oldham, and in that way he had come to be associated with this question of Indian railways, and was, therefore, invited to occupy this chair. In the early days of railway communication, when the genius of George Stephenson created the railway system of this country, his father was associated with him and with his son Robert Stephenson in the development of railways. It was more than half a century ago since the firm founded by his father began the manufacture of locomotive engines, and it would be interesting if he could give some short account of the course of business in the manufacture and supply of locomotive engines in this country. When England actually created the railway system and founded the first machine works for the construction of locomotives all the world were bound to come to England, so his firm began the supply of material first to England; then it passed on to France; then to Germany; then to Austria; then to Italy; afterwards to Spain; and finally to Russia. Of course, it was impossible that England could expect to keep this gigantic commerce to itself; as other nations became instructed and acquired sufficient knowledge they began constructing for themselves, and finally they had, by piling up a wall of tariffs, excluded England from the Continental markets. To show how serious this matter was, he might mention that in one year firms with which he was associated in business had contracts in Russia for material for over £100,000, which they manufactured and delivered in one year, but at this moment not one single pound's worth of that description of manufacture was now sent from England to Russia. That showed the necessity of endeavouring to develop new markets. Of course, following this trade with European countries there had been a great development of railways in Australia and other colonies, then in India, and latterly a very rapid expansion of the railway system in South America. Many present knew what a collapse there had been in the finance of Argentina and South America generally, and that those markets which had employed many great works and a teeming population were now demanding nothing, so that employers in his position instead of adding to the prosperity of the country were adding very materially to the ranks of the unemployed. There were numbers of skilled artisans in the North who were ready and anxious to work to whom they could offer no employment. That showed how vitally interested in this question were the great mass

of the population. He would remind them that India contained 285,000,000 or 290,000,000 of people under our rule, which was one-fifth of the computed population of the globe, and yet for the service of that population we had only one-tenth of the railway system which now obtained in the United States, which had a population of something like 65,000,000 only. Of course, it might be said that America was a rich country, and India a poor country, but why was America a rich country? Could her resources have been developed without a railway system? For example, there was a great manufacture of iron and steel in the United States, but Nature had not been very generous in her disposal of the material. In the Pittsburg region there was coke; and ironstone in the North and Lake Michigan; but the manufacturers of Pittsburg had to convey their mineral 1,000 miles before it met the coke; on the contrary, the manufacturers of Illinois, who were nearer the ironstone, had to convey the coke the same distance. The United States, by the development of corn lands, had created great districts which were supplying corn to this country, and they were now carrying corn a distance of 1,000 miles at the same rate as they were conveying it some ten years ago a distance of 300 miles, so that by the development of railways they had actually extinguished this distance by 700 or 1,000 miles. Mr. Walton had pointed out that in India they were only laying down railways at the rate of some 500 miles per annum, though it was acknowledged by everyone who had governed India that 20,000 or 30,000 miles were immediately required. Conversing on this subject with Lord Ripon, he supported the testimony of other Governors-General, which had been quoted by Mr. Walton, that railways were absolutely necessary, and that in season and out of season they should press on the people of England the necessity of developing the railway system of India. It surely was but a moderate demand to ask that 20,000 miles should be built in the course of ten years, that would be 2,000 miles per annum, which, at the average cost of £5,000 a mile, would be £10,000,000 per annum. What did that mean to the iron trade of this country? The weight of iron and steel in a mile of railway was something like 300 tons, so that on 2,000 miles of railway there would be 600,000 tons of material per annum required. The total produce in this country was something under 7,000,000 tons, so that this demand would be equivalent to 10 per cent. of our total manufacture. As our demand and supply were very nearly balanced at present, it would be seen that the addition of something like 10 per cent. to the current consumption would make all the difference between prosperity and adversity, between slack and full employment to the working people. The financial question was, of course, the serious one. It was difficult to see how the Imperial Government could be expected to give a guarantee for the construction of Indian railways, or how, having regard to the demands made on them, they could persuade

the House of Commons to accede to it. But when they were told that for the last thirty years the total amount of gold and silver absorbed was stated on the authority of the Bank of Bengal to have amounted to £356,000,000, which was the balance of profit of trade in India, one was led to inquire why Indian administrators had not been able to tap this source of wealth, and to induce the natives of India to place this amount of treasure where it would receive a fair amount of interest, and assist in developing the resources of the country rather than to hoard it. He did not think this was an impossible idea. He had recently a communication from a gentleman, saying that he had been sent on a mission to India to see whether it was not possible to raise there capital for the construction of tramways, and, by arrangement with the native financiers, he had been able to obtain more than half the capital required for the Madras tramways. Now, considering that 20,000 miles of railway and £200,000,000 sterling only was required, which was only about half the amount of gold and silver which had been hoarded in India during the last 33 years, he thought it was by no means impossible to solve this currency question by drawing from the Indians themselves their hoarded money. Mr. Walton had conferred a great service upon the manufacturing interests of this country in bringing forward, and in devoting himself to, this question, and he concluded by proposing a hearty vote of thanks to him.

Mr. C. ARTHUR HEAD said there was very little to add to what had been said by Mr. Walton, although the subject was of immense importance to manufacturers in the North of England. The whole point was the financial one. They were all fully alive to the great importance of railway extension, and rapid extension, but he did not see that it was for commercial men to say how the Government were to set about it. They were quite ready to make and develop railways if the money could be found to pay them for what they did. He did not think financial people in England would find the money unless they were satisfied that they would have a fair interest for it. It was not for him to say whether it should be 3, 4, or 5 per cent., but he believed, if the Indian Government would guarantee 4 per cent., the money would be found. Indeed, there was very little doubt the money would be found if the public were satisfied they would get not less than 4 per cent., but as long as the rupee was falling in value, the public would not come forward unless the Indian Government would give a guarantee that it would not fall below a certain rate. Possibly the Indian Government might say that they would guarantee a certain rate per cent. for a certain length of time for so many thousand miles of railway, and if so, the public might be willing to run the risk after that time. They all knew that railways did not pay so well at first, but when the district was developed, they did pay much better, and probably, therefore,

if the interest were guaranteed for a certain time, the public would take the risk afterwards.

Lieutenant-Colonel E. L. MARRYAT, R.E., said they would all agree that many more miles of railways were wanted in India, but the point was, how could they get them made? Mr. Walton made a bold proposal that the English Government should lend £50,000,000, but he thought, when Sir William Harcourt brought out his budget, he would have quite enough to do without providing for Indian railways; nor did he think the Government would go in for borrowing, or guaranteeing in sterling, until Indian finances were placed in a much less precarious position. There was no doubt the Indian Government was enormously interested in the extension of railways, not only because it increased the wealth of the country, and enabled it to get increased land revenue and improved postal and military facilities, but because, as the owners, or joint owners, of every trunk line which led to a port its own property was vastly improved by the construction of branch lines; every mile of railway made as an extension, and every additional ton of traffic created, would be carried over the Government trunk lines. The Government, therefore, could well afford to be liberal to anyone who would come forward and make these branches. The question was, what could private enterprise do? They had heard a great deal about private enterprise during the last ten years from Viceroy and Secretaries of State, but what had been the result? Practically hardly anything. Why? When the late Lord Lawrence was Viceroy, and someone said to him that public works should be left to private enterprise, he said, "I know what that means; that means robbing the Government." That feeling still prevailed in official circles. Many gentlemen in high positions could not bear the idea of any company making 8 or 10 per cent. They thought at once they must be robbing the Government. It seemed to be supposed that there were a large number of philanthropists in the city of London who were prepared to go out and make railways in India, and take all risks, and be content to get 3 per cent. He had been in the City a good many years, but had not come across any of them. Certain proposals had lately been put forward to encourage private enterprise, and he could not say they were altogether bad, because they embodied two or three which he put forward himself at Manchester some few years ago, as, for instance, that the branches should be worked at a moderate rate, and have a rebate on the traffic brought on to the main lines, but the Government thoroughly damned the proposal by saying that directly the branch line paid 4 per cent., out of which it had to pay home charges, the rebate should stop, which meant that the line, if it did well, might earn 3 per cent., but that if it did any more it would be robbing the Government. That spoilt the whole thing. Again, there was such continuous change of *personnel* in high places that

there was no fixed policy. Going back about twelve years, there had been seven Secretaries of State, five Viceroy, and five Public Works Ministers, and innumerable other changes. New ideas were coming forward every day, and they never could get a policy of any sort fixed. There was the guaranteed system of the broad gauge; then the State system with the metre gauge; then in 1882, there was private enterprise; then, in 1884, they went back again to the broad gauge; in 1889, State railways; in 1892, another policy of partnership with the railways, the Government providing three-quarters, and the company the other quarter; and so it went on, and probably before long it would be private enterprise again. It was the same with the gauge question. If a man offered to make a line anywhere at a cheap rate on the metre gauge he was told—"No, you must have the broad gauge; it would only cost another £1,000 a mile," which simply meant condemning the whole thing, as it made all the difference between a profit and a loss. They did not seem to be able to realise that the first thing wanted was a railway of some sort. A metre railway could carry passengers and a ton of goods as well as a broad gauge, and cost about £1,000 a mile less to make. A metre gauge, or even a 2 feet railway, was a great deal better than none at all. Half a loaf was better than no bread, but they would insist upon the whole loaf, and, consequently, they did not get anything. Another difficulty was that there was nobody to deal with you at the India-office; they received you very politely, thanked you very much, and said they would send out your proposals to India, and, by the time you were old and grey-headed, you got a reply to the effect that the Secretary of State regretted that he was unable to entertain your proposals. This went on year after year, and you got no forwarder. The question was of vast importance, and something ought to be done. His impression was, that if Sir James Kitson, and other gentlemen of political influence, could get a committee of the House of Commons to lay down some rules which the Government of India should follow, and create some tribunal in London or in India to which its proposals might be submitted, threshed out, and an answer given, something might be done. If such a tribunal met for two months in the spring, the Indian Government might send home a representative, and promoters of schemes would get their answer straight off. Several other points might be discussed, as, for instance, whether India should not borrow in silver to make its railways, whether the rivalry of the State railways did not render private enterprise impossible, as Sir Louis Mallet always said it did. Also whether, if that were the case, it might not be possible for the Government to dispose of some of its commercial railways to companies, and employ the proceeds in building lines which no company would take up. Anyhow, the present want of system was an utter farce.

Mr. JAMES RICHARDSON, M.P., said he had had the privilege of hearing Mr. Walton speak on this subject in the country, and was struck with the great knowledge of it that he possessed, and also had the privilege of introducing him to the Secretary of State for India. He found the whole difficulty lay with the Chancellor of the Exchequer. The India-office was ready to listen to any scheme for the development of railways, but the difficulty was, where was the money to come from; but surely there must be some way out of the difficulty. One way had been suggested by Colonel Marryat, that a committee of the House of Commons should be appointed to consider various schemes, and allusion had also been made to the scheme the India-office had now issued, and if this were not liberal enough he believed the Government would be prepared to make further concessions. He was quite satisfied they would not get a guarantee, but he believed the English people were alive to their own interests, and if the Indian Government made a sufficiently liberal offer capital would be forthcoming to carry out these schemes.

Sir JAMES BAIN said that in 1882 he spent a considerable time in India, and went over a great part of the country, with the view of ascertaining in what manner the railway system could be more fully developed. On his return, with the consent of Lord Hartington, then Secretary of State, he submitted his views to the India-office, and since then there had been a considerable extent of railways made, but nothing like what ought to have been. He fully endorsed what Mr. Walton had said as to the importance of a very largely extended scheme of railway communication, its advantages to the natives of India, and also to the manufacturing interests of this country, but the question, as had already been said, was where was the money to come from. For his own part he did not see where it was to come from. The Indian Government was falling behind at the rate of something like £3,000,000 a year, and under those circumstances it could not be expected to find money for such an extensive development of railway industry as Mr. Walton had pointed out. It was quite true that a large amount of money went to India from this country for wheat and other produce, which was very extensively hoarded. That system still went on, and he suggested that the rich natives should be applied to with the view of inducing them to subscribe for the making of railways, as rich men did here. But he was informed, when in India, that the natives would not give their money for such purposes; they preferred to lend it out to the ryots on land, getting 10, and sometimes 12 per cent. Mr. Walton said they only wanted £50,000,000, but Sir James Kitson said they wanted £200,000,000. If even only the sum named by Mr. Walton were raised here by a guarantee of the Imperial Government, it could be raised at 4 per cent., but that would mean £2,000,000 a year of increased taxation, which he did not think the Chancellor of

the Exchequer would be likely to include in his Budget for the sake of making railways in India. He was entirely in favour of all Mr. Walton had said, but he could not see any answer to the financial question. From what the Chairman had said, he thought the people to be principally benefited were the makers of steel and the makers of rails and locomotives. He did not know whether they were willing to come forward with the money, but they seemed to be the parties who would derive the greatest benefit from it.

Mr. ERNEST L. WALFORD said he had had a great deal to do with Indian railways in the city, and he had spoken to many people about it. He rather gathered, from those who had had experience in India, that, whatever might be said, the Government or the officials did not like private persons to do anything. If a man was at the head of a district he did not like to have an independent company there, and a lot of railway officials who were perfectly independent of him, and who wanted to run the line as they liked, without his interference. The consequence was, that although the Government said they were in favour of private enterprise, the officials were very unfavourable to it. The great thing was to encourage private enterprise, but that was not to be done by guaranteeing the lines; in fact, it was this system of guarantees which had stifled private enterprise. It had educated the people to look for a guarantee, instead of trusting to the merits of the undertaking. The London and North Western and the Midland lines were built without any guarantee. The first thing to do was to get rid of the State Railway Department and wind it up, selling the lines on the basis of the returns, as shown by the Blue-books, and with the purchase money so received the Government might, if it was desired, construct more lines. What they really wanted was a permanent Commission, like the English Railway Commission, to have the entire control of railways in India, and to sit in London.

The vote of thanks was then put, and carried unanimously, and the meeting adjourned.

Mr. W. MARTIN WOOD writes:—Mr. Walton's paper on Indian railway extension, Sir James Kitson's speech, and those which followed, were all so much in one vein as to make it very desirable to have shown there is another side of the subject. The programme of raising £50,000,000 of capital with which to construct 10,000 additional miles of Indian railways during the next four or five years is grand enough to take one's breath away in these days of Anglo-Indian financial despair. But as Mr. Walton sincerely desires to dispel our depression by unfolding his dream of prosperity for India and profits for ironmasters and other English interests, we are bound to examine his benevolent scheme. It may not be

quite fair to estimate the future of Indian railway exploitation by its past history, but it must have struck many who listened to the flattering hopeful tale illustrated by Mr. Walton's figures and photographs that he has scarcely given due heed to that history. He does not seem to realise—though he makes certain admissions on this point—that Indian railways have never paid as a whole; and that, up to date, they drag a heavy deficit in their financial wake. Up to a few years back there were arrears of interest, drawn from the current revenues of India, to the debit of the guaranteed railways, amounting to some 33 crore of rupees, which, with compound interest due to the Indian taxpayers, may be taken at 40,000,000. Since then, "the loss by exchange" on Indian railway account, Rx. 16,830,000, in the 14 years ending this March, has to be added, making the lee-way that the Indian railway system has yet to fetch at over £60,000,000 sterling. Probably Mr. Walton considers he swept away all that when he cited the magnificent statement, on the authority of General Strachey and Sir Charles Bernard, that "the saving to the Indian people affected by railways" (up to 1884) is "not less than £40,000,000 sterling annually." Many of us remember that astounding statement; but the saving is "ill seen," and the process of that calculation yet remains to be worked out. Possibly, it was based on an arithmetical sum as between the cost of haulage per ton by bullock-cart and that by rail; but this is a very superficial way of treating the matter, and as the railway rates are always kept as high as the traffic will bear, there must be a big gap somewhere in that thumping estimate of "saving." Amongst other Indian conditions to which Mr. Walton fails to attach due weight is the inadequacy of the expensive method of railway carriage to deal with bulky raw products over the hundreds of miles of the Indian routes. When last we had a similar sanguine estimate of what railways would do for India put before us (by Mr. J. S. Jeans, in 1887) that old-fashioned engineer, the late Daniel Adamson, put it in this way—whereas bullock-power costs sixpence per ton per mile (surely too high?), railways can carry at a halfpenny; but, he added, "if India had deep and large waterways these would bring down the cost of carriage to one-hundredth of a penny per mile;" and General Rundall on the same occasion pointed out that if the fine waterways already existing in India were freely extended (as they could be at an incomparably less cost than iron-ways) and suitable steam barges used, the cost of carriage of bulky Indian produce would only be one-tenth of what it is now. In one respect Mr. Walton's survey of the great subject is beyond praise. That is the courage with which—founding himself on high authorities—he demonstrates the political-financial responsibility of the United Kingdom to India. If he can effectually impress this on our leading statesmen, and, *inter alia*, secure an Imperial guarantee for Indian public works, he will have deserved well of the Empire.

Mr. J. BARR ROBERTSON writes:—As, owing to want of time in the discussion on Mr. Walton's paper, I had not the opportunity of expressing my dissent on one of the points raised, I now desire to say that Mr. Walton condemned the Indian Government for not having introduced the gold standard in 1873. Had they done so they would have been able to sell the Council bills at 1s. 11d. or thereabouts. But along with the exchange at 1s. 11d., there would have been, in common with all gold standard countries, a fall in India of the prices of all native produce and foreign goods of from 30 to 35 per cent. This fall in the prices of all native produce would have made it impossible to collect out of 65 or 70 rupees the land tax, which has been cheerfully paid out of 100 rupees, and this fall in the prices of native produce would have been an infinitely greater calamity for the people of India than a rate of exchange even as low as 1s. 2d.

Mr. M. M. MURZBAN writes:—Mr. Walton quotes Lord Kimberley's despondent views in regard to "financial pressure" quite precluding "extension of railways in India." I humble venture to inquire what "financial pressure" has to do with the extension of railways in India. If Government will guarantee a certain rate per cent. for what are called "guaranteed railways" it can, with equal facility, raise loans for constructing railways without the intervention of private companies. To Mr. Walton's paper is appended a Table giving a list of railways proposed to be constructed in India and adjacent countries. In this list I see Mr. Walton refers to the Karachi-Delhi route. From my own personal knowledge, I do not see the necessity of the Bhatinda-Bhawalpur route; and, further, I fail also to see the wisdom of having a still shorter and more direct route by railway from Delhi to Karachi, at the present moment. For years to come, our object should be to construct railways where there are none, and which will not interfere with other already existing lines. When this Delhi-Karachi direct route was first proposed, I wrote in one of the papers of the province through which this direct route was to be laid down, and pointed out the inadvisability of such a course, and I can only say in a few words what I then wrote. Great as the difficulties are in raising the necessary capital for extending railways in India, it is not a wise policy to construct railways which practically compete with existing lines. Such would be the case if the more direct and shorter route from Delhi to Karachi was adopted; it would simply divert all the wheat traffic which is at present carried by the South Punjab and Delhi Railways, thus resulting in a heavy loss to the revenue of that line. True, the new, shorter route would tap a new district, but, I submit, that this should not be at the cost of a line already existing, and this is what is eventually going to be the case. What we need at the present moment is a scheme of railways that will not interfere with the traffic of existing lines.

Correspondence.

REFRIGERATING APPARATUS.

Perhaps you will be good enough to permit us to make a few remarks upon the letter from Mr. Sterne that appeared in the *Journal* of March the 23rd. In the Linde compressor there is neither oil injection nor water-jacket. Compression is accomplished without raising the temperature of the ammonia gas above blood-heat, so that not only is the work expended in compression much reduced, but the complicated arrangements for oil injection, cooling, and separation, are avoided. The open air condenser and direct expansion pipes are not "quite peculiar to the De la Vergne system." We have used both for many years, and we have just completed two installations in which there are no less than twelve miles of direct expansion pipes.

For the Linde British Refrigerating Company, Ltd.,

T. B. LIGHTFOOT,

Managing Director.

35, Queen Victoria Street, London, E.C.,
24th March, 1894.

Obituary.

SIR PHILIP CUNLIFFE-OWEN, K.C.B., K.C.M.G., C.I.E.—After a long and painful illness Sir Philip Cunliffe-Owen died at Lowestoft, on Good Friday, 23rd inst., and by his death the Society of Arts loses one of its foremost members, and a vice-president of many years standing. Very full notices of his career have appeared in the daily papers (*Times*, 24th March, &c.), so that in these columns only a brief summary is needed of the life of one who was so closely associated with the Society, and so popular among its members. He was elected a member in 1864, and came on the Council in 1879, following his brother, Lieut.-Colonel Cunliffe-Owen, who served in various capacities on the Council in 1851-3, and 1858-60.

Sir Philip was the third son of Captain Charles Cunliffe-Owen, R.N.; he entered the Royal Navy at the age of twelve, but retired after five years service, on account of ill-health. In 1854 he joined the Science and Art Department, and in the following year he commenced the great work of his life in connection with exhibitions, on his appointment as one of the superintendents of the British section of the Paris Exhibition of 1855. In this position he proved his organising capacity, and in 1857 he was appointed deputy general superintendent of the South Kensington Museum, under Sir Henry Cole. In 1860, he became assistant-director, which office he held until the retirement of Sir Henry Cole, in 1873, when he was appointed director. In 1862, he was made director of the

foreign sections of the London International Exhibition. At the Paris Exhibition of 1867, he was appointed assistant executive commissioner. At the Vienna Exhibition he was secretary of the Royal British Commission, under the immediate commands of H.R.H. the Prince of Wales, and at its close he was made a C.B. In 1875, he went to the United States as executive commissioner for the Centennial Exhibition at Philadelphia, and carried out the preliminary arrangements for the British section there, but afterwards resigned and was succeeded by Sir Herbert Sandford. In 1878, he acted as secretary to the Royal Commission for the Paris Exhibition, after which he was made a K.C.M.G. and C.I.E.

The founders of the International Fisheries Exhibition of 1883 were fortunate in securing the aid of Sir Philip in the organisation of that exhibition, and its success was undoubtedly due to his supervision and initiative, though nominally he was only a member of its council. In the same capacity he controlled to a very large extent the administration of the Health Exhibition (1884) and the Inventions (1885), though he was fortunate in having, in all cases, the active aid of the Prince of Wales, who was president of the three exhibitions, and the energetic co-operation of the Duke of Buckingham, and of Sir Frederick Bramwell, the chairmen of the councils of the Health and Inventions Exhibitions, respectively. The Colonial and Indian Exhibition was under a Royal Commission, of which Sir Philip was secretary. The successful result of his labours on this occasion was rewarded by promotion to the rank of K.C.B. This was the last eminent public service of his life. In 1889, the English Government took no official part in the Paris Exhibition, or no doubt he would have again been appointed secretary to a Royal Commission. His health, too, was failing. His untiring energy, and the enormous amount of work he took upon himself, were wearing him out. He suffered seriously from ill-health at the time of the Colonial Exhibition, and never really recovered. It had been his earnest desire to visit the Chicago Exposition last year, as a member of its Royal Commission, but the state of his health did not permit it. Last year he resigned his post of Director to the South Kensington Museum and retired to Lowestoft.

Sir Philip Owen's popularity amongst all with whom he came in contact was very great. His singularly genial manner, and his well-known kindness of heart made him many friends, especially among the important and numerous classes from whom the contributors to great exhibitions are drawn. His great experience, wide knowledge of the world, and native shrewdness, made him a valued counsellor in a large circle of personal friends, by whom his ever ready advice and friendly judgment will long be missed.

CAPTAIN CAMERON, R.N., C.B.—The sudden death of Captain Verney Lovett Cameron, the African traveller, on Monday, 26th inst., deprives the Society of Arts of a distinguished member, who

so lately as the beginning of the present month showed his interest in the Society's work by presiding at a meeting of the Foreign and Colonial Section, when Mons. Edouard Foa read a paper on his "Travels in the Basin of the Zambesi." Captain Cameron's eminent services have been fully set forth in the public Press, and it is only necessary here to refer to his connection with the Society. In 1876 he was elected an honorary life member "for his energy in exploring and laying open to commerce districts of Equatorial Africa hitherto absolutely unknown." On January 23rd, 1877, he read a paper on "The Trade of Central Africa, present and future," for which he was awarded the Society's silver medal. On May, 23rd, 1882, he addressed the Society on "The Gold Fields of West Africa," in which paper he gave an account of his travels with Captain Burton in that region. He read a paper on "The Congo and the Conference in reference to Commercial Geography," on March 17th, 1885, and on February 19th, 1889, one on "Slavery and its relation to Trade in Tropical Africa." His last paper was on "Chartered Companies in Africa," on February 17th, 1891. Captain Cameron was a frequent attendant at the meetings, and joined in the discussions, more especially when the subject before the meeting referred to Africa. He was born in 1844, and was therefore only fifty years of age. Previous to the commencement of his extensive travels in Africa, in 1872, he served with distinction in the Abyssinian campaign of 1868.

General Notes.

RUSSIAN MATCHES.—The match-making industry in Russia has largely developed. In 1891 there were 271 factories producing 144,750,000 matches, of which about 38,000,000 were non-phosphorus or safety matches. The excise duty is one kopeck on a box containing from 225 to 300 matches, and less in proportion to smaller boxes. Three kopecks is about equal to a penny. The manufacture of sulphur matches dates from the most ancient times. The manufacture of phosphorus matches had been established in Russia already before 1840, but its dimensions were for a long time very limited, partly because the bulk of the Russian people continued to use the flint and tinder for striking a light, and partly because the manufacture, as well as the use of phosphorus, was subject to very restraining regulations. Since 1859, only with the establishment of factories and free trade did the production begin to grow.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

APRIL 4.—"The Elements of Beauty in Ceramics." By C. F. BRINNS. SIR GEORGE BIRDWOOD, K.C.I.E., C.I.E., will preside.

APRIL 11.—“London Coal Gas and its Enrichment.” By PROF. VIVIAN LEWES.

APRIL 18.—“Design Applied to Carpets.” By ALEXANDER MILLAR.

APRIL 25.—

MAY 2.—

MAY 9.—“Telegraphs and Trade Routes in Persia.” By COLONEL WELLS.

INDIAN SECTION.

THURSDAY, APRIL 26, at 4.30 p.m.—“Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh.” By SIR AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieutenant-Governor of the North-West Provinces and Oudh.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on Tuesdays, at Eight o'clock:—

APRIL 17.—“Tasmania and the forthcoming Hobart International Exhibition, 1894-95.” By J. F. ECHLIN.

MAY 29.—“Education in Victoria.” By Prof. C. H. PEARSON, M.A., LL.D.

APPLIED ART SECTION.

Tuesday Evenings, at Eight o'clock:—

APRIL 10.—“The Evolution of Decorative Art.” By HENRY BALFOUR, M.A. SIR GEORGE BIRDWOOD, M.D., K.C.I.E., C.S.I., will preside.

MAY 8.—“Pewter.” By J. STARKIE GARDNER. PROF. W. C. ROBERTS-AUSTEN, C.B., F.R.S., will preside.

MAY 22.—“Decorative Art in connection with Elementary Education.” By SELWYN IMAGE.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

CAPTAIN W. DE W. ABNEY, C.B., F.R.S., “Photometry.” Three Lectures.

LECTURE I.—APRIL 2.—White light—Sources of light—Standard light—Quality of lights from different sources.

LECTURE II.—APRIL 9.—Principles of measurement—Different methods of Photometry—Oscillation and scintillation in light measurement—Colour no bar to measurement.

LECTURE III.—APRIL 16.—Applications of Photometry to various scientific purposes.

HENRY CHARLES JENKINS, A.M.Inst.C.E. “Typewriting Machines.” Two Lectures. April 30; May 7.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 2...SOCIETY OF ARTS, 8 p.m. (Cantor Lectures.) Captain W. de W. Abney, “Photometry.” (Lecture I.)

Farmers' Club, Salisbury-square Hotel, Fleet-street, E.C., 4 p.m. Mr. W. Anker Simmons, “Amendments to the Agricultural Holdings Act, 1883.”

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, Town-hall, Westminster, S.W., 7½ p.m. Mr. E. Lloyd Pease, “Gasholder Construction.”

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. J. W. Lovibond, “Colour as a means of Quantitative Estimation.” 2. Mr. W. C. Young, “The Natural Diminution of the Dissolved Organic Matter in the Water of Rivers.” 3. Mr. H. Louis, “Note on an Improved Specific Gravity Bottle.”

Surveyors, 12, Great George-street, S.W., 8 p.m. Adjourned discussion on Mr. Howard Martin's paper, “The Report of the Local Government and Taxation Committee of the London County Council on the subject of the Rating of Ground Values.”

Actuaries, Staples-inn-hall, Holborn, 7 p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. Paper on “Babylonian Exploration.”

Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Dr. L. Parkes, “Sanitary Laws and Regulations governing the Metropolis.”

TUESDAY, APRIL 3...Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. A. Fleming, “Electric Illumination.” (Lecture I.)

Central Chamber of Agriculture (at the House of the Society of Arts), 11 a.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Charles Hunt, “The Construction of Gas Works.”

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

WEDNESDAY, APRIL 4...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. C. F. Binns, “The Elements of Beauty in Ceramics.”

Microscopical, 8 p.m. Conversazione at St. Martin's Town-hall, Charing-cross, W.C.

Archæological Assoc., 32, Sackville-st., W., 8 p.m.

Obstetrical, 20, Hanover-square, W., 8 p.m.

THURSDAY, APRIL 5...Linnean, Burlington-house, W., 8 p.m. 1. Mr. R. H. Burne, “The Aortic-arch System of *Saccobranchus*.” 2. Mr. H. N. Ridley, “The Orchideæ and Apostasiaceæ of the Malay Peninsula.”

Antiquaries, Burlington-house, W., 8½ p.m.

Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. Alfred C. Calmour, “Shakespeare—his boyhood, youth, and manhood, with some account of the Play-houses, Players, and Playwrights of his period.”

Royal Institution, Albemarle-street, W., 3 p.m. Mr. Seymour Haden, “The Etching Revival.” (Lecture I.)

Inventors' Institute, 27, Chancery-lane, W.C., 8 p.m.

FRIDAY, APRIL 6...Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting. 9 p.m., Prof. V. Horsley, “Destructive Effects of Projectiles.”

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. W. H. Hamer, “The River Humber.”

Geologists' Association, University College, W.C., 8 p.m.

SATURDAY, APRIL 7...Royal Institution, Albemarle-street, W., 3 p.m. Mr. J. A. Gray, “Life among the Afghans.” (Lecture I.)

Journal of the Society of Arts.

No. 2,159. VOL. XLII.

FRIDAY, APRIL 6, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

On Monday evening, 2nd inst., Captain W. DE W. ABNEY, C.B., F.R.S., delivered the first of his course of Cantor Lectures on "Photometry."

The lectures will be printed in the *Journal* during the summer recess.

Proceedings of the Society.

SIXTEENTH ORDINARY MEETING.

Wednesday, April 4, 1894; Sir GEORGE BIRDWOOD, K.C.I.E., C.S.I., LL.D., M.D., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Aldridge, Rev. Robert, 27, Westfield-road, Edgbaston, Birmingham.

Bower, James, 8, Vernon-gardens, Gateshead-on-Tyne.

Evans, Joseph, Guildhall, Grantham, and 3, Barrowby-road, Grantham.

Grove, William, 63, Baker-street, W.

Hawkins, Isaac Thomas, Vale-house, Somerton, Somerset.

Hertslet, Edward Cecil, Elm-house, St. Julian's Farm-road, West Norwood, S.E.

Oldham, Charles F., The Shiel, Weybridge, Surrey.

Orloff, Prof. Nicholas, 20, Finborough-road, West Brompton, S.W.

Partington, Miss Jessie, 16, Pembridge-square, W.

Treble, Charles F., 20, Queen's-parade, Clapham-
junction, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Barber, James, Encombe, Endlesham-road, Balham, S.W.

Gowland, William, 35A, Russell-road, Kensington, W.

Meaby, Michael Charles, St. Luke's Vestry-hall, City-road, E.C.

Middleton, Richard John, 18, Finch-lane, E.C., and 15, Balfour-road, Highbury, N.

Pettigrew, George, St. Paul's-road, Middlesbrough.

Pilditch, John Thomas, 12, Cambridge-road, Battersea-park, S.W.

The paper read was—

THE ELEMENTS OF BEAUTY IN CERAMICS.

By CHARLES F. BINNS.

In view of the extent and variety of the ceramic productions of the present day, it may well be asked whether there be any principle upon which merit may be considered; whether any artistic canon exist for the guidance of the critic.

There are some who hold that in ceramic work the clay must always be *en evidence*, that the wheel is the only suitable appliance for the shaping of a plastic material, and that only such decorations are admissible as can be applied to the clay itself. Again, a second school holds that not the clay as in a natural state is to be considered, but what it becomes in the fire; that stoneware and porcelain are worthy of appreciation in themselves, without regard to their plastic and earthy origin. There may be said also to be a third class who believe that any means may be used for producing form and decoration, provided only that the result be beautiful. Let us examine further the bases of these claims.

I will premise that we cannot judge of any work pretending to be a work of art unless we leave out of the question the conditions under which it was produced. We value the specimens in an ethnographical museum because they reveal to us the manners and customs of a bygone age. We regard them as steps in education, as stages in the evolution of a people, but the moment a work can be judged as artistic, we remove it from the department of ethnography. We place it upon a platform with the art work of all ages and all nations, to stand or fall by another criterion. What, then, do we require as the elements of beauty, and for what do we seek in our criticism of ceramic works of art?

In every department of artistic work we demand that the executant shall exhibit perfect control over his material; this is, in fact, the germ and essence of artistic practice,

Without this faculty the poet and the painter may conceive grand subjects, but they cannot convey their ideas to the multitude; the poet must have control of words, the painter of colours. In like manner the sculptor and the engraver must be executants if we are to derive any pleasure from their work. And the potter? The docile clay is obedient to his touch, so obedient that a rude hand or an unskilful finger may mar the whole work. It cannot be then that we require of him a lower degree of skill than of the painter; he works in a different sphere but his work demands no less knowledge and dexterity.

To begin at the bottom, the first element we look for in ceramic beauty is form, a pure and graceful line; this must be regarded as of the greatest importance, because if the form be poor, no decoration, however elaborate or costly, can ever beautify. The ancient Greeks produced most beautiful forms and they seem to have used various means; the vases were shaped from the plastic clay upon the wheel, and ornamentation belonging to the form was moulded and applied. At the same time, the highest degree of finish is observable; the potter was not content to leave the mark of his finger upon the clay, the surface of each piece was beautifully smoothed and endowed with a delicious texture. The potter's control over his material was complete, and he was able to create the works of art which now charm our vision. But a Greek vase was beautiful when it left the hand of its maker, and it owes little or nothing to the fire. If pieces dried in the sun could have been preserved to us we should find them equally as beautiful as those we have. These fictile triumphs are, in fact, glorified clay—"only this and nothing more;" their beauty is the result of a grand conception perfectly realised by a skilful hand. There can be no doubt that, though the origination of a work of art may be an inspiration, the ability to execute the same work is the outcome of severe study and long training. A high civilisation had caused in Greece a high ideal; the works of the potter, as of the sculptor, were judged by a lofty standard, and for this reason the examples that remain to us exhibit such a high degree of excellence.

Beauty of line and texture is not produced merely by a fortuitous chain of circumstances, it is the outcome of thought and care. A graceful line is always pleasing, whether it be severe or florid, whether its character be classic or barbaric. The desirable elements

are continuity and proportion. If we analyse the beauty of a given line we find that its power to please depends upon the harmonious relation of one part to another, and upon the perfect balance of the whole. Beyond the beauty of outline there is an æsthetic value in surface. Silk is more beautiful than cotton because of its texture, and in like manner fine clay is more beautiful than coarse, high finish than a rude surface. The judgment of the sense of touch is not to be despised.

There is a tide in the affairs of clay, and in its flow it reaches the point where clays are influenced and changed by fire. All clay will not bear fire, all will not submit to it, but at a certain point all amenable clays become affected as to their condition and appearance by the action of heat. Stoneware, which is glazed by means of salt in the first and only fire, assumes the delicately-mottled texture that we well know. Porcelain gains its fine whiteness and translucency, and emerges from the heat a new thing. The fire has a very important part to play in influencing the beauty of any ware. Though fire cannot supersede the beauty of form, it can and does enormously control the beauty of texture. But there is one thing the fire cannot do, it cannot turn bad work into good, any more than a coat of varnish can correct the drawing in a picture. Let a piece made of fine clay, of pure form and perfect finish, be submitted to the oven, and the heat will purify and beautify the whole, but any condition lacking the result must be failure.

In dealing with the clays that may be called "fine," and which will submit themselves to be influenced by fire, we find that certain combinations are necessary; we need a substance which will obey the impulse of the oven and permit itself to be purified, but which will at the same time decline to bend before the fire or to bow itself to the tyrant heat. To arrive at this result is a matter of very fine discrimination, and we find sometimes that we are compelled, in order to attain our desire, to sacrifice certain other qualities in the clay; the substance may not be plastic enough to be formed upon the wheel, or it may be necessary that the surface should not be disturbed by the hand. Recourse must then be had to moulding as a means of producing form; and here it is found that a much wider field is opened than that provided by the wheel alone. The forms producible upon the potter's wheel are limited and plain, while the use of the mould enables

us to produce a practically inexhaustible variety; besides this we are now in a position to execute replicas of sculpture and embossment, statuettes and elaborately modelled works can be reproduced, and in a material which will withstand the fierce heat of the furnace to become unassailable by decay. In the production of the element of beauty in form we have, whether in the wheel or in the mould, all the means that we require, but a satisfactory result must depend upon the proper use of our facilities—the opprobrium which attaches to a badly moulded piece must likewise belong to that which is carelessly formed by the hand, the cause of success in each case being care and skill, in other words, control over material.

The fine clay having had its nature changed by the fire, it cannot be right to treat it any longer as clay. Porcelain is a precious substance, a thing so delicate and pure as to have worthily excited in the ancients a feeling of veneration. We have no need to go back to its earthy origin, we can deal with it as it is to our great advantage. A most important element in the beauty of porcelain is the texture of its surface, and as porcelain can hardly be complete until it be glazed, the quality of that glaze becomes of the greatest value. This part of the subject has been so ably dealt with here by Mr. Rix that I do not propose to pursue it further, only stating that to appreciate the artistic value of glaze one has only to handle a piece of Japanese fine porcelain.

Much controversy has raged around the question of decoration as to the treatment of ceramics after firing. Looking at the traditions of the decoration of porcelain, we find it has always been dealt with as a substance which stands alone in the hands of the decorator. The painter may use ivory for his miniatures, but his colours cannot be fixed by the fire; the goldsmith may overlay shells and set jewels, but the only possible union between his form and decoration must be mechanical; to the porcelain decorator alone it is given to fix imperishably his colours, to unite his gold decoration with the form by means of the fire, and thus to attain results which are denied to the artist in any other material.

In considering the elements of beauty found in decoration, let me state that beauty cannot exist in originality alone. I believe there are some artists and some critics who would pardon any fault so long as the work may claim to be original. I confess I cannot share their

feelings. Bad work is always bad, and the pity is that sometimes those who are capable of original idea will not take the trouble to learn how to intelligibly express themselves.

A glance at the shelves of any of our museums will satisfy the most casual observer that there are numberless examples of work—I cannot say “art”—in existence whose originality is after all but a “double dose of original sin.” I admit that where a beautiful piece has also claim to be original its value is increased, but the point under consideration is not value but beauty.

In decoration there is a great deal to be said for the eternal fitness of things: only let it be decided what constitutes “fitness.” To treat a piece of terra cotta as a work in clay is manifestly correct—the senses give evidence that the material is clay, the clay itself can be worked and fired. To treat a piece of porcelain as clay is equally wrong, because the material cannot be worked as the clay can, while the fire totally changes its nature.

It is fit then to decorate earthenware and pottery in the clay—toolings, embossments, and incisions are all suitable, but their fitness does not necessarily constitute beauty; the power of the work to please lies not in the fact that it is suitable, but in the quality of its execution. To place all clay work upon a level because it is appropriate is absurd; we might as well compare the contents of the British barrows with those of the Etruscan tombs. Decorative work needs to be both suitable and excellent to be entitled to the term artistic.

We need not go further than the admirable works produced at Lambeth to illustrate the fitness and excellence of clay work. Messrs. Doulton have glorified their material, and their productions are for the most part truly artistic.

The treatment of white earthenware in vogue at the present day is not to be commended; it is either cheaply decorated by means of the printing press or gaudily finished in distant imitation of porcelain. The apostle of earthenware has yet to arise who will give us beautiful and low priced dinner services. In giving voice to this sentiment I may be regarded as a traitor in the camp, but while I regard much of our English earthenware as satisfactory so far as it goes, I admit that in the majority of cases it bases its claim to consideration upon price rather than upon artistic merit. The exceptions to this are found where the makers are endeavouring to treat their

stone dinner plates as a cheap substitute for china, and that this is the case is shown by the abundance of such terms as "opaque china" and "semi-porcelain."

Let us turn now to the elements of beauty in the decoration of porcelain as distinct from earthenware. We have somewhat cleared the ground by disposing of the question of form, which must always largely influence decoration, and we are left free to inquire what materials are at our disposal and what methods are open to our use. There can be nothing more beautiful than the pure surface of a piece of fine porcelain. The translucent paste and the tender glaze appeal to our affections in a manner that must be irresistible to the artist, and it is not to be wondered at that porcelain, as a material, has received the adulation, I had almost said adoration, of kings.

I have in my mind a series of examples shown at Chicago, of the æsthetic value of pure porcelain; they came from various sources, from the royal manufactories of Copenhagen and Sèvres, from Berlin and from Japan, laying aside for the moment our English productions. The Copenhagen porcelain illustrates the beauty of simplicity perhaps more than any other modern work. The decorations are entirely under the glaze, painted in the most delicate colours—grey blue, myrtle green, and drab—on the pure white of the paste. The colours are passed through the *grand feu*, and a most delicious sense of atmosphere is imparted by the slight opalescence of the glaze—the elements of beauty here present themselves both to the eye and the touch. The drawing is perfect and well adapted to the forms, while the texture is all that can be desired.

From Sèvres and Berlin we have examples of the æsthetic value of single colours wedded to simple forms, but with this result the chemist has more to do than the artist. To appreciate, however, the possibilities of these pure tints we must examine the productions of the Sinico Japanese artists. We all know the wondrous works produced by the Chinese in the seventeenth century, the soft radiance of the *sang de bœuf*, and the rich delicacy of the peach bloom. In this path the modern Japanese potters, or rather a few of them, have started, and some of the results they have attained are perfectly marvellous. The means used are simple, any English ceramist can tell what ingredients are employed; but the method? "Aye, there's the rub." In truth, those Eastern artists can teach us many

things, and I am disposed to slightly alter the ancient proverb and say, *Ex Japonia semper aliquid novi*. A question I put to the Japanese gentleman in charge of these precious objects at Chicago, elicited the fact that they are consigned to New York and to Paris, but not to London!

The element of beauty derived from colour in ceramics is not to be lightly dismissed, and here again we must discriminate between pottery and porcelain. In the former we have always to consider the colour of the clay itself. There is great colour value in Greek pottery and in German stoneware, while the tones that we consider most fitly to belong to clay are those which will withstand the hard fire. These tones are given a certain quality of subdued strength by the intensity of the heat, and the result is a pleasing harmony between the clay and the decoration. Upon German stoneware, for example, the salt glaze unites with the cobalt or manganese used as colour producers and brings them into harmonious relation with the grey of the ware. A similar result is observable upon the white and enamelled earthenwares of Rhodes and Damascus; the colours are apparently mingled with a whitish earth, and the soft glaze is spread over all. There is a fertile source of decorative beauty in coloured glazes, whether upon a tinted or a white paste. In the flowing and melting of a glaze we have varied depths of tone, the nearest approach in fictile work to the delicate shading given by textile folds. The colours of Bernard Palissy are little more than tinted glazes, and much of their beauty is owing to the fact that they were melted upon a reticulated surface, producing by their flow subtle gradations of light and shade. In modern days this flow of glaze is utilised most successfully by many makers of embossed tiles, on some of which the soft effects rival the beauties of Chinese celadons. Some perfect examples of this style of work have been produced in America by the Low Tile Company, where the effect of skilful modelling is developed by soft tints in glaze, while in this country the Campbell Tile Company, Messrs. Maw, and the Burmantoft Company, have executed many beautiful works.

A rich and beautiful effect is produced in the Rookwood pottery of Cincinnati by a combination of under-glaze colours and coloured glaze upon tinted clays. Two colours of clay are used, deep red and cream. Upon the unglazed piece graduated colours are laid and impasto subjects painted; the whole is then

coated with a rich mellow glaze slightly tinted in warm or cold tones. The result is very pleasing, the colours possess a depth and richness that I imagine could hardly be attained were any one of the conditions left unobserved.

Thus in pottery we are able to draw elements of beauty from various sources, but in dealing with porcelain we find the conditions somewhat different: the unburned material is much more tender, the fire much more severe. Colours passed through the porcelain oven, with but few exceptions, perish, what these exceptions are I have indicated when speaking of the Copenhagen ware.

Cobalt, nickel, manganese, and chromium, are the most refractory; other stains are used to but a limited extent and with small success. This fact has led to the use of softer porcelains by those who were desirous of extending the underglaze palette, and several other colours, yellow, pink, pale blue, chestnut brown, and various greens, have been placed at our disposal, none of which however could be used in the intense fire required for the glazing of hard porcelain. I have already spoken of the single colours shown at Chicago, and with the exception of these and the low tones produced by Copenhagen, we have little to show in underglaze porcelain decoration.

In the treatment of porcelain with enamel or muffle colours and gold there is a wide field to be traversed. The Chinese long ago led the way in the productions classified by collectors as Ravenswing black, Famille rose, and Famille verte. Dresden, Sèvres, Bow, Worcester, Chelsea, and Derby, gave us a variety of styles in the use of enamel colours, and their beauty may be said to consist in two things, the delicacy of the material and the daintiness of the treatment. There is in the deliciously painted tea cups of Sèvres a suggestion of perfume from the boudoir of a high born dame. The toys of Chelsea breathe the atmosphere of the era of the Georges. Both are fit for their purpose, and are excellent examples of artistic skill and taste.

Many are the ways in which colour can be used upon porcelain to beautify form. The principle of painting pictures upon vases is one which I do not care to defend, and which I venture to think has already become obsolete, but there are very many legitimate methods of applying colours. Tinted grounds have been used since the day of the Chinese works that I have mentioned, and there are no tints that can compare for purity with those possible upon porcelain: the translucent paste shining

through the colours affords the keenest pleasure to the artistic eye.

Decorative painting is a branch of treatment that it would be difficult to exhaust. The objects of nature lend themselves admirably to adaption and can be largely utilised to beautify and develop form. The Japanese artist can in this, also, read us a lesson, for in his work we have perfect adaptation allied to realistic execution. The Western artist, in his work, is inclined to sacrifice one to the other. Realism is allowed to over-shadow adaptation, or *vice versa*. The true course is to be found in the ideal; in utilising the poetry of nature to express the thought of the artist. This was admirably achieved by the men whose work we admire upon the *pâte tendre* of Sèvres, their painting gains immeasurably by being burned into the porcelain, but they sacrificed neither accuracy nor poetry in their decorative treatments. When our porcelain decorators shall learn to read the book of nature, when the sketch-book is deemed inseparable from the palette, then our decorative porcelain will enter upon a new stage of existence, and we shall no longer consider a china painter as outside the pale of art.

The use of metallic decorations upon porcelain has been many times discussed, but I do not remember to have seen it dealt with as apart from the decoration of pottery. To gild a Greek vase would be vandalism, but I have already stated that there can be no analogy between terra cotta and porcelain. The latter has been regarded from the date of its discovery as a substance upon which it is proper to use arts and decorations of all kinds, and it can be no more incorrect to gild porcelain than to gild silver. There is no doubt that metallic decorations are often applied in a gaudy or a senseless manner, but this only goes to prove my contention that beauty lies not so much in the substance used as in the manner of use. From China and Japan, from Dresden and Sèvres, from Bow and Chelsea, we have numbers of examples of the proper use of gold upon porcelain, and it may be maintained in art if not in ethics—that the end justifies the means.

The life and vigour imparted to a scheme of decoration by a judicious use of metal is not to be despised. We value the introduction of bright gold in an illuminated manuscript, why then should we deny the ceramic artist the use of that which will enable him to add force and brilliancy to his work?

The value of pure design is an important

element of beauty in ceramics, it enters largely into the production of form and the arrangement of decoration. But it often happens that the designer is not highly educated in the mechanical arts, and that the craftsman is not skilful in design. Division of labour may be carried to a point where it destroys all artistic feeling, but there is I think much to be said for collaboration. There is nothing more beautiful in ceramics than a harmonious design perfectly executed. Set the originator of the design to decorate a vase, and the probability is he will not succeed, place the design in the hands of a skilful art workman, and he will execute it perfectly in all its detail, to the delight of the designer and the satisfaction of the critic. Besides this, the time of the designer is saved, a point of some importance in a manufactory; a partial sketch will serve the purpose of the workman, so that several designs may be in course of execution at once. I am aware that there are critics who regard the word "manufactory" with abhorrence, and I am free to admit that the atmosphere surrounding such a place is not conducive as a rule to the production of fine works of art. We must however take things as we find them, and as we have a public demanding to be supplied with plates, cups, and vases at low cost, all we can do is to see that we supply the maximum of artistic taste and manufacturing skill with the minimum of horror and expense.

As in mechanics force may be misapplied, so in art skill may be misdirected. The value of a good design is that it directs the skill of the craftsman and enables him to make the best use of his powers. I confess that to me a fine design loses half its beauty by crude execution, while, on the other hand, the most accurate work may be altogether wasted in carrying out a worthless idea.

The designer's work is largely used in providing material for reproduction by mechanical process. By this means we are able to place presentable wares upon the table of the poorest and to offer employment to large numbers of persons whose unaided work would be valueless from an artistic point of view.

The human hand is undoubtedly the most satisfactory medium for the execution of any art work, not because there is any actual advantage in the hand itself, but because by its means the artist and the craftsman can impress life upon their work. At the same time there is nothing more objectionable than bad hand work. If we are to have inferior work let it be relegated to the machine; the

reason for using the hand is that its capabilities are greater than those of any mechanical contrivance.

To conclude, let me express once more my conviction that the elements of beauty in ceramics are to be found mainly in pure design and accurate execution, and I refuse to admit that defects constitute merit. In criticising a painting we do not look for imperfections in technique as evidence that the artist's hand has alone been employed, but the reverse is the case; we demand, and rightly, that hand work shall supersede every other means in artistic production. It cannot, then, be in decorative art that we look upon imperfect execution in hand labour as an advantage. I am forced to believe, from the examples I constantly see exhibited by so-called "art" dealers, that there are some who differ from me, and who prefer a brilliant dash of colour or an abnormal shape to anything that may be called skilful. It was not by such as these that the ceramic reputation of ancient Greece was made or the gems of the Chinese ovens produced. At the latest of the International Exhibitions the ceramics of Great Britain held a front place, but that place is not their's by any hereditary right. It has been won by skill properly directed, by enthusiasm and by personal devotion. If that position is to be maintained in the future, there is no room for any retrograde movement. In English manufactures the reproach is often voiced that the fathers have by diligence amassed fortunes for the sons to disperse; if that reproach have any foundation we shall vainly search in future years for beauty in our ceramics, all will be sordid and mean. If our manufacturers are to hold their own in competition with the world they must apply themselves with earnestness to their work, and they must set before themselves and their workmen a high ideal.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said that Mr. Charles Binns had favoured them with a very valuable paper, for it was the free expression of the views and opinions of a man on a subject of great national importance, and almost universal interest, with which he was himself practically and intimately acquainted. It was just the sort of paper the Society of Arts best liked to secure for its members, and what added immensely to its interest was that Mr. Charles Binns, as the son of Mr. Richard Binns, the author of "*A Century of Potting*," and the founder, under its construction since

1851, of the Worcester Royal Porcelain Company, embodied, so to say, in himself the whole tradition of the ceramic art of England, from its rise about the middle of the last century. Of course, there had been pottery of a kind indigenous to England from the 16th century. There are "Greybeard" and "Bellarmine" stoneware jugs, dating from the 16th century, of undoubted English manufacture, although directly copied from German and Dutch examples; and already, in the 17th century, potteries had been established by the Dutch, both at Lambeth and in Staffordshire. But these were, he believed, all for the production of stoneware, and were all inspired by the stoneware art of Holland. The porcelain works at Bow, Chelsea, Plymouth, Bristol, Worcester, and Derby, all sprung up about the middle of the last century, and, for the most part, their inspiration was entirely French. Chelsea was the earliest of them, but, from the beginning, the works at Worcester, thanks to the science, the learning, and the artistic skill of their founder, Dr. Wall, took the lead in the porcelain manufacture of England; and on George III. visiting them, in 1788, he sanctioned their bearing the designation by which they have ever since been known, of the Worcester Royal Porcelain Works. He thoroughly agreed with the reader of the paper that beauty of form was the first thing to be desired in pottery; and, that gained, the decoration should be carefully subordinated to it, that is in the sense that it should not violate the integrity of the form of the object to which it was applied. Mr. Charles Binns had stated that the decoration of pottery with landscapes had become obsolete, but he had recently seen a magnificent dinner service, the price of which was £3,000, in which every piece was most exquisitely painted in landscape, in utter violation of all the recognised principles of ceramic art. Even the dishes for holding large joints, furrowed with grooves for the gravy, and the perforated drainers of the vegetable dishes, were painted all over their furrows and perforations with these charming landscapes, producing a ludicrously incongruous effect, which made one blush for one's country. As a poor man, who prized artistic things, he had followed with great interest the great development in recent years of the manufacture of white earthenware, and he thought that it had now reached to very high artistic excellence. Of course there was an objection to printed decoration; and he ventured to make the suggestion, although aware of the repugnance it might excite, that often in the production of cheap ware of this sort, its decoration might be done by stencilling better than by printing; or the decoration might be limited to the beauty of the tints given to the glaze. He had an earthenware dessert service, exhibited by Wedgwood at the Paris Exhibition of 1868, for which he paid only 30s., but which completely satisfied him; and the plates and dishes were simply glazed in mottled greens and browns in the centre while round

the rim they bore a raised wreath of conventionalised white and pink daisies. The service would equally become the table of a peasant or a prince. He strongly deprecated lowering the standard of artistic excellency to secure cheapness. What Mr. Binns had said on that point reminded him of an incident that befell himself some years ago. He had missed a train at the Crystal Palace, and waiting at the station door, observed a small group of "corner men," who were presently joined by another from the town, who at once addressed them:—"Well, I have been to the old lady, and the carpet is so many feet long, and so many feet broad, and can't be properly beaten under ten shillings, and she won't give more than half-a-crown, and what shall we do?" They had almost determined to have nothing to do with the job, when one, more "English" than the rest, joined in:—"Well, half-a-crown is half-a-crown, and I say take the half-crown and *beat the carpet according*;" and they all walked off to do so. The cheapening of artistic pottery is only possible by limiting the amount of the decorative work on it, and not by scamping it, which really gives us the *minimum* of artistic taste and manufacturing skill, with the *maximum* of horror and expense.

MR. HUGH STANNUS, after referring to the interesting character of the paper generally, said the distinction drawn between the two branches of the ceramic art, earthenware and porcelain, was obviously correct; they were two distinct materials, and the treatment suitable for one was in many instances utterly unsuitable for the other. Form was the first element of beauty in ceramic art, and the Greeks were perfect masters of form. It was an interesting study to walk through the vase rooms at the British Museum, commencing with the archaic specimens, and to compare the profiles with those of the early or archaic architecture, the two seemed to run in perfectly parallel grooves. The circular profile of the pots could be placed side by side with the profiles of the early Doric capitals; and conic sections which appear to have governed the profiles of the vases, were analogous to the beautiful profiles in the Parthenon, as had been pointed out by Professor Longfellow. Of course, it would be strange if it were not so, because in those times all art was one; and the man who designed a capital one day might be called to superintend the profile of a pot the next. The whole atmosphere of Greece was permeated by this fact. The Inner and Outer Potteries were almost under the shadow of the Acropolis, and no doubt the men who made their vases were continually walking over that Acropolis. The colour of Greek ware was not so beautiful as that of the Japanese and later work, but the Greeks were not great chemists, and could not use the *grand feu*; in fact, their clay would not stand a great heat, and therefore one could not expect the same colours as were produced in the 17th and 18th centuries. Still, their colour had its own

value, and the relative amounts of black and red in Greek vases was very instructive to the artist. Coming to porcelain, he understood that was made from a primary rock (whilst pottery was from tertiary), which had already been exposed to fire. No doubt the origin of all the factories which sprung up in Europe in the 18th century was the embassy of Louis XIV. to China, which brought back those wonderful specimens of porcelain, that had set everyone admiring, and then endeavouring to imitate its great charm of colour and texture. He would submit that hardly sufficient stress had been laid on the point that the decoration should not only be subordinate to the form, but should emphasize the form and bring it out; it should be such as could be applied to no other form. In the mind of the artist, the form and the decoration should exist together as an inseparable unity. The Greeks were wonderfully able in the way in which they decorated their mouldings. Almost universally, the moulding was decorated simply by lines, which show the vertical section, and in perspective reproduced the beautiful profile of the form. The combination of the vertical lines (which show the section) and the horizontal band (which show the plan of the vase), was the ruling principle in Greek decoration; and no one had done anything so simple and beautiful since. All later improvements had been in colour through the aid of the chemist. He was somewhat struck by the Chairman condemning printing, and recommending stencilling, but of course the latter might be something more than mere flat opaque work; an artist might produce those beautiful shades of colour in which one melted away and then reappeared, as was done in many underglaze colours in porcelain; and if that kind of stencilling was referred to, he quite agreed with it, otherwise he would protest against stencilling on pottery. He had some Japanese stencilled work, but they were all flat plates or saucers; he could not imagine stencilling being applied effectively to a spheroidal surface like that of a vase. He must say he was rather disappointed that Mr. Binns had not brought some specimens to illustrate the many interesting points in his paper, but, nevertheless, they were under a great obligation to him.

The CHAIRMAN said he should like to point out that in India were preserved the unbroken traditions of antiquity, and that in that country the potters' field was invariably found close to the gate of every town and at the entrance to every village. Mr. Stannus had referred to the potters' field of Athens being close to the Acropolis, that was simply because before Athens was the city of Athene, the Acropolis was the city of Erechthus, and in the antique city the potters' field was always just outside the gate.

Mr. BOURNE (Messrs. Doulton's) said all potters were much indebted to the Greeks for their wonderful examples of purity of form. The beautiful decorations put on porcelain could, to a

great extent, be applied to modern earthenware, because much of this was of so fine a texture that it could hardly be distinguished from porcelain.

Mr. G. G. MACWILLIAM said stencilling, in the ordinary acceptation of the term, was already applied to earthenware, only it went by the less euphonious name of "sponging," and it was scarcely ever seen in England, only being made for less civilised parts of the world. Some of it, however, was so well done that it would take a practised eye to tell whether it was "sponged" or printed. During the last few years printing had been done so well and so delicately engraved that it was applicable both to china and earthenware. The great desideratum in cheap pottery was to reduce the decoration and make it as simple as possible. No doubt within the next two or three years earthenware would be still lowered in price, though it was even now cheaper than it had ever been before.

Mr. MARTIN WOOD said it was very difficult for uninstructed laymen to get any definite information on some of the points raised in this paper, and he should be glad if these points could be made a little clearer. Broadly speaking, there were three kinds of decorative design; first, the conventional, including the ritualistic and the traditional; secondly, the geometrical, including the circle as well as the square, arabesques, &c.; and thirdly, the imitative, including landscapes. The Chairman condemned the latter, but he thought that perhaps there might be something to be said for foliage and flowers, and he should like to know if they were permissible; in fact, he should like to know which of these classes of decoration people ought to admire, purchase, and cultivate, and how far they might go in each case. Reference had been made to the fine colour of the Chinese celadons, and he thought there was something similar in the glazed tiles of Scinde, Mooltan, and Northern India.

Mr. WOLSTENCROFT remarked that nothing had been said with reference to Japanese *faïence*, such as Satsuma ware, in which the great desideratum was that the surface should be crackled. In all English ware that seemed to be studiously avoided, though by the crackling of the surface the light was broken up, and a beautifully soft effect produced. It was produced by the pate contracting at a different rate from the glaze, and this was considered by the Japanese to be the great beauty in ware of that description.

The CHAIRMAN proposed a hearty vote of thanks to Mr. Binns for his paper, which was carried unanimously.

Mr. BINNS, in responding, said that allusion had been made to the horrible decoration of the Japanese, but, in defence of them, he might say that this had sprung absolutely from European demand; and that some of the artists he had indicated, though he could

not recall their names, had set themselves to revive the ancient glories of the Chinese ovens; and also of the ancient Satsuma ware. He did not share the strong objection some felt to printing; it might be used very effectively; the trouble was that it was often wasted, that the engraving was bad, and the printing slovenly. Generally it was a cheap imitation of porcelain, which it should not be. Very few recognised the absolute distinction between earthenware and porcelain. He had purposely avoided saying anything about crackle, because it came under the head of glazes, which had already been treated fully by Mr. Rix. There seemed a general feeling of disappointment that he had not produced an array of specimens, but he did not like to bring pieces from the Worcester works without explaining how they were produced, which he was not at liberty to do; and he thought if he had anything to say worth hearing it would not need a show, which savoured something of the shop. It was perfectly true, as Mr. Stannus said, that the decoration should emphasize the form, but he had dwelt very strongly on that point in speaking at Chicago, and did not wish to repeat here what had already appeared in print. The Chairman seemed to disagree with him on the question of cheapening production, but what he said was merely in defence of manufactories, because he knew that many people hated them, and thought that nothing good could come out of them. They had thousands of hands employed, and people were demanding dinner and tea services at cheap rates; were they to discharge their workpeople and refuse to supply the public requirements? Their answer was, they must give them the minimum of horror and the maximum of excellence in pots. Under the circumstances, they certainly wanted an apostle of earthenware, for there was no really artistic earthenware in England. There was some which could hardly be distinguished from porcelain, but it was not porcelain. They wanted a cheap dinner service which would please the artistic eye. He did not quite see where it was to come from, but he had seen some glimmerings of light occasionally in various directions, and was not without hope that before long something satisfactory in that line would be produced.

Miscellaneous.

TELEGRAPHIC COMMUNICATION BETWEEN ENGLAND AND INDIA.

The following is an extract from a letter, dated February 28, 1894, from the Secretary, Bengal Chamber of Commerce, to Mr. E. O. Walker, C.I.E., late Superintendent of Telegraphs in India, who read a paper before the Indian Section of the Society on the above subject on February 8:—

"1st. That the rate for messages is high requires

no demonstration. Unfortunately, the effect of exchange has been made apparent by an increase, within the past few days, of the charge per word to Rs. 3 7 as. *viâ* Persia, and Rs. 3 2 as. *viâ* Turkey. The difficulties of maintaining establishments and distance to be traversed are all allowed for, and yet the opinion is that the charge is a high one.

"2nd. As to increase of traffic, the Chamber believes that, with a reduction of charge, there would follow an increase in the volume of traffic.

"Generally, the Chamber considers that much good would result if it could be arranged that codes should not be subject to frequent revision, and if, in this direction, some stop were put to the activity of the International Telegraphic Conference."

INDIAN CURRENCY.

Mr. J. BARR ROBERTSON writes:—Mr. Hyde Clarke makes the following accusation: "Thus Mr. Barr Robertson and his supporters incriminate the administrators of India here and in that region for not having prevented the fall of silver, for having caused the fall of silver, and for having thereby caused enormous losses to the population of India on 300,000,000 of silver ornaments. . . . Did the Government cause the fall of silver, and can they arrest it in the future? If not, these charges should be withdrawn, and the people should not be deluded or deceived by them." (See *ante*, p. 389). Neither in my paper nor in my reply did I blame the Indian authorities "for not having prevented the fall of silver," nor "for having caused the fall of silver," and I made no reference whatever to the losses to the population of India on silver ornaments. Mr. Hyde Clarke is therefore under a misapprehension as to what I said, and I wish to make this disclaimer as his strictures do not apply to me.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

APRIL 11.—"London Coal Gas and its Enrichment." By PROF. VIVIAN LEWES.

APRIL 18.—"Design Applied to Carpets." By ALEXANDER MILLAR.

APRIL 25.—

MAY 2.—

MAY 9.—"Telegraphs and Trade Routes in Persia." By COLONEL WELLS.

Papers for which dates have not yet been fixed:—

"Reproduction of Colour by Photography." By CAPTAIN W. DE W. ABNEY, C.B., F.R.S.

"Automatic Gem and Gold Separator." By WILLIAM S. LOCKHART.

"Application of Electricity to the Disinfection of Sewage." By MONS. HERMITE.

"Nickel." By A. G. CHARLETON, A.R.S.M.

INDIAN SECTION.

THURSDAY, APRIL 26, at 4.30 p.m.—“Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh.” By SIR AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieutenant-Governor of the North-West Provinces and Oudh.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on Tuesdays, at Eight o'clock:—

APRIL 17.—“Tasmania and the forthcoming Hobart International Exhibition, 1894-95.” By J. F. ECHLIN.

APPLIED ART SECTION.

Tuesday Evenings, at Eight o'clock:—

APRIL 10.—“The Evolution of Decorative Art.” By HENRY BALFOUR, M.A. SIR GEORGE BIRDWOOD, M.D., K.C.I.E., C.S.I., will preside.

MAY 8.—“Pewter.” By J. STARKIE GARDNER. PROF. W. C. ROBERTS-AUSTEN, C.B., F.R.S., will preside.

MAY 22.—“Decorative Art in connection with Elementary Education.” By SELWYN IMAGE.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

CAPTAIN W. DE W. ABNEY, C.B., F.R.S., “Photometry.” Three Lectures.

LECTURE II.—APRIL 9.—Principles of measurement—Different methods of Photometry—Oscillation and scintillation in light measurement—Colour no bar to measurement.

LECTURE III.—APRIL 16.—Applications of Photometry to various scientific purposes.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 9...SOCIETY OF ARTS, 8 p.m. (Cantor Lectures.) Captain W. de W. Abney, “Photometry.” (Lecture II.)

Cleveland Institute of Engineers, Corporation-road, Middlesbro', 7½ p.m.

Scottish Society of Arts, 117, George-street, Edinburgh, 8 p.m. 1. Reports by Committee on Messrs. Blaikie, James N. Miller, and H. Ramsay Taylor's papers. 2. Professor R. Mullineux Walmsley, “The Decimal Problem and its Urgency, with some remarks on its Solution.” 3. Mr. R. G. Hislop, “An Automatic Safety Hoist Door.”

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mr. St. George R. Littleale, “A Journey across Central Asia.”

British Architects, 9, Conduit-street, W., 8 p.m. Paper on “The Council Chamber and its Accessories.”

Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m.

TUESDAY, APRIL 10...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. Henry Balfour, “The Evolution of Decorative Art.”

Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. A. Fleming, “Electric Illumination.” (Lecture II.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. Charles Hunt's Paper, “The Construction of Gas Works.” 2. Reception by the President and Council.

Photographic, 50, Great Russell-street, W.C., 8 p.m. Mr. Birt Acres, “Polarisation practically applied to Photography.”

Anthropological, 3, Hanover-square, W., 8½ p.m. 1. Prof. R. W. Reid, “The Skull of a Microcephalic Hindu.” 2. Prof. A. C. Haddon, “Ethnographical Studies in the West of Ireland.”

Colonial Institute, Whitehall-rooms, Whitehall-place, S.W., 8 p.m. Hon. James Inglis, “Recent Economic Developments of Australian Enterprise.”

Asiatic, 22, Albemarle-street, W., 4 p.m.

WEDNESDAY, APRIL 11...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Prof. Vivian Lewes, “London Coal Gas and its Enrichment.”

Geological, Burlington-house, W., 8 p.m. 1. Prof. T. G. Bonney, “Mesozoic Rocks and Crystalline Schists in the Lepontine Alps.” 2. Lieut.-General C. A. McMahon, “Notes on some Trachytes, Metamorphosed Tuffs, and other Rocks of Igneous Origin, on the western flank of Dartmoor.”

Sanitary Institute, Parkes Museum, Margaret-street, W., 8 p.m. Mr. Lewis H. Isaacs, “The Construction of Roads and Streets from a Sanitary point of view.”

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

North-East Coast Institute of Engineers and Ship-builders, Sunderland, 8 p.m.

THURSDAY, APRIL 12...Antiquaries, Burlington-house, W., 8½ p.m.

Society for the Encouragement of Fine Arts, 8 p.m. Second Conversation at the Royal Institute of Painters in Water Colours, Piccadilly, W.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. F. Seymour Haden, “The Etching Revival.” (Lecture II.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Prof. W. E. Ayrton's paper, “The Best Resistance for the Receiving Instrument with a Leaky Telegraph Line.” 2. Prof. W. E. Ayrton, and Mr. T. Mather, “Transparent Conducting Screens for Electric and other Apparatus,” and “An Astatic Station Voltmeter.” 3. R. E. Crompton, “Cost of Electrical Energy.”

Mathematical, 22, Albemarle-street, W., 8 p.m.

FRIDAY, APRIL 13...Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting. 9 p.m., Prof. J. J. Thomson, “Some Properties of the Electric Discharge through Gases.”

Astronomical, Burlington-house, 8 p.m.

Philological, University College, W.C., 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Science Schools, South Kensington, S.W., 5 p.m. 1. Discussion of Prof. Henrici's paper on “Calculating Machines.” 2. Mr. P. L. Gray, “The Minimum Temperature of Visibility.” 3. Dr. C. V. Burton, “The Mechanism of Electrical Conduction.”

SATURDAY, APRIL 14...Botanic, Inner-circle, Regent's-park, N.W., 3½ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. J. A. Gray, “Life among the Afghans.” (Lecture II.)

Journal of the Society of Arts.

No. 2,160. VOL. XLII.

FRIDAY, APRIL 13, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

FOREIGN & COLONIAL SECTION.

The meeting announced for Tuesday evening, 17th inst., has been unavoidably postponed to Thursday, 19th inst., when a paper on "The Tasmanian Exhibition" will be read by G. COLLINS LEVY, C.M.G.

CANTOR LECTURES.

Captain W. DE W. ABNEY, C.B., F.R.S., delivered the second of his course of Cantor Lectures on "Photometry" on Monday evening, 9th inst.

The lectures will be printed in the *Journal* during the summer recess.

Proceedings of the Society.

SEVENTEENTH ORDINARY MEETING.

Wednesday, April 11, 1894; J. NORRIS PIMM, Chairman of the Committee for County Purposes, Corporation of London, in the chair.

The following candidates were proposed for election as members of the Society:—

Fairfield, Edward, C.M.G., 7, Park-place, St. James's, S.W.

Walpole, George, 89, New Bond-street, W.

Ward, H. Snowden, Hawthornden, Woodside-park, N., and 6, Farringdon-avenue, E.C.

Ward, Mrs. (Catharine Weed), Hawthornden, Woodside-park, N.

The following candidates were balloted for and duly elected members of the Society:—

Flintoff, Robert J., Haxby, Crumpsall-lane, Crumpsall, Manchester.

Gritton, Joseph, care of Mrs. Cawood, Box 76, Johannesburg, South Africa.

Meldrum, James Jones, Atlantic Works, City-road, Manchester.

Smith, Isaac Cardmaw, Springfield, Chelmsford, Essex.

Thackeray, Col. Edward Talbot, R.E., C.B., V.C., 128, Upper Tulse-hill, S.W., and Athenæum Club, S.W.

Wild, Charles J., Weybank, Broadwater, Godalming, and 113, Cheapside, E.C.

The paper read was—

LONDON COAL-GAS AND ITS ENRICHMENT.

By PROFESSOR VIVIAN B. LEWIS,

Superintendent Gas Examiner to the Corporation of the City of London.

Although the first centenary of coal-gas was celebrated two years ago, another thirteen will have to elapse before we can commemorate the completion of the first hundred years of its practical use in London as an illuminating agent, and as the past few years mark a distinct epoch in the history of the gas industry, and as the air is full of changes yet to come, I propose to bring before you in this paper, in as brief a space as possible, a history of the past, as far as it concerns our great city, and a review of the present condition of our gas supply from the point of view most likely to interest the consumer. In doing this I shall restrict myself, as far as possible, to the area in which I am most interested, that is, the City of London, but it must be borne in mind that the largest proportion of the metropolitan district north of the Thames is supplied by the same great company that supplies the City, and that most of my remarks will apply equally well to the gas supplied to the district south of the Thames by the South Metropolitan Gas Company, and also to the portion of North-East London supplied by the Commercial Gas Company.

The first mention of any gas lighting in the City was in 1807, when an experiment was made in lighting part of Whitecross-street and Beech-street with gas, and this having proved successful, the Chartered Gas Company obtained the first gas Act in 1810, granted by Royal Charter, hence the name "Chartered," their lighting powers extending to the City of London, Westminster, and borough of Southwark.

In 1814, mains were for the first time laid in the City, and on the 9th of November, 1815, the Guildhall was illuminated by gas. In that year, also, the Chartered Company entered

into a contract with the Commissioners of Sewers to light several streets in the wards of Cornhill and Cripplegate.

After a lapse of seven years, the City of London Gas Company was formed, and obtained a gas Act, in 1817, to light very nearly the same area.

Up to 1823, the two companies having powers over practically the same area, there was keen competition between them, but in 1822, Sir W. Congreve, who had been appointed, on behalf of the Crown, to inquire into the gas supply of the metropolis, advised that districts should be assigned to the companies, and although this was keenly opposed by them, an Act was passed in 1823 carrying his recommendation into effect. The City was then divided between the City of London Gas Company and the Chartered Company, the City company having that portion which comprises the western and southern part of the City as bounded by Aldersgate-street, Cheapside, and Fenchurch-street, whilst the Chartered Company supplied the portion comprising the northern and eastern part of the City. This arrangement, of course, put an end to competition between the two companies, and left the gas supply as a monopoly in their hands.

The representatives of the companies had to appear annually before the Corporation to tender for lighting the streets, but, as there was no alternative between accepting their tenders or returning to oil lamps for City illumination, this had but little effect upon the price which the company were able to charge for gas. At these meetings it was the custom to draw the attention of the companies to the reduction in the price of gas which competition was effecting in the districts surrounding the City, and it was then that the companies announced their intention of reducing or retaining the price of gas to the citizens during the ensuing year.

In 1825, the price of gas was 15s. per 1,000 cubic feet, but, by gradual reductions, it had fallen to 7s., in 1844, and after much agitation it was further reduced, in 1847, to 6s. per 1,000 cubic feet. Dissatisfaction, however, continued to be felt at this price, as it was contended, by experts in the subject, that the City was entitled to a much greater reduction, and that, owing to the large consumption concentrated into a small area, it was entitled to gas at a lower price than any other portion of the metropolis, and the gas companies were informed that, if competition were offered, it might be accepted by the Corporation, unless

further reduction in the price of the gas was at once made. The price suggested by the Corporation Committee as being an equitable one was 4s. per 1,000, and the companies were required to state whether they would, by gradual reductions, or within a reasonable period, lower the price to this figure per 1,000 cubic feet. This the companies positively and definitely refused to do, stating that it would be impossible to supply gas profitably at that price; and they further declined to give any guarantee that it would be reduced below 6s.; and it was this refusal that first led to the organisation of the Great Central Gas Consumers' Company. The promoters of this company started with the proposition that the City was, from its local conditions, entitled to have gas at a cheaper rate than the rest of London; and they also, under the advice of skilled experts, averred that a price of 4s. per 1,000 cubic feet would be largely remunerative to the company; and, being supported by a numerous and influential body of citizens and gas consumers, and being further supported by the Corporation, they applied to Parliament for an Act in 1849, and again in 1850, but their application was unsuccessful on both occasions. In 1849, however, they had applied to the Corporation for permission to put down pipes in the City, and had offered to execute a deed, by which they bound themselves to supply gas to the consumers at a price never to exceed 4s. per 1,000 cubic feet; and further, to reduce the price to 3s. 6d. and 3s., whenever they could pay a dividend of 10 per cent. to their proprietors, the then City solicitor, Charles Pearson, and Alexander Angus Croll, at one time engineer to the Chartered Gas Company's Brick-lane station, being the chief promoters.

The Commissioners of Sewers, relying upon the promises made, accepted the offer, and a deed, dated February 12, 1850, between the Great Central Gas Consumers' Company and the Commissioners of Sewers was accordingly executed for carrying out the arrangement. The promoters were allowed to lay down pipes, and, with the large influence they had acquired, they applied for, and gained, an Act of Incorporation as the Great Central Gas Consumers' Company, and in 1851 also entered into their first contract for public lighting.

As soon as the Great Central Gas Consumers' Company was formed, in 1849, the other companies, stimulated by fear of competition, at once reduced the price of gas to 4s., but the Commissioners of Sewers feeling,

from the attitude which the gas companies had taken before competition had been suggested, that it was only by keeping up the competition that the price could be kept down, supported the new company on the understanding that 4s. per 1,000 cubic feet would be henceforth the maximum price of gas in the City, which price might still further be ultimately reduced, and the compact entered into with the company was subsequently incorporated in the Company's Act of 1851, the result being that the citizens had gas supplied to them at 4s. per 1,000 cubic feet until the passing of the Metropolis Gas Act in 1860.

About the year 1857, when the northern companies settled their several districts, the gas companies surrounding the City combined, with a view of stopping competition, and in view of the opposition received from delegates from various local boards in the metropolis, who were defending the public interest against the coalition, Parliamentary committees were appointed, in the years 1858-59, to inquire into the gas supply of the metropolis, and, as a result of their labours, the Metropolis Gas Act was passed in 1860. The Bill was introduced into Parliament in April, 1860, and was referred to a Special Committee in the House of Commons, who, after hearing a considerable amount of evidence, arrived at certain decisions which were apparently so favourable to the public and so distasteful to the gas companies that they withdrew their representatives altogether from the committee, which concluded its labours on the 25th of June. The gas companies meanwhile employed themselves in raising opposition to the Bill on its third reading, and succeeded in obtaining its recomittal; and finally, the gas companies having obtained the withdrawal from it of those features which they considered objectionable to their interests, the Act ultimately passed.

In 1861, the three companies supplying the City raised the price of gas to 4s. 6d., and the Commissioners of Sewers, who had been relying upon their agreement with the Great Central Gas Consumers' Company, took counsel's opinion as to their being able to increase the price, and a special case was argued before the Court of Common Pleas in 1862, and decided in the companies' favour, this judgment being confirmed upon appeal.

By the Act of 1860, the price of ordinary gas was fixed at a maximum of 4s. 6d., with power to the Home Secretary to grant an increase up to a limit of 5s. 6d., should the necessity arise. After the passing of this Act, the affairs of the

gas companies became very prosperous, and in 1866 the Corporation promoted a Bill to construct gasworks, and to supply gas in competition with the three companies supplying the City, but after a fortnight's inquiry it was rejected by a Select Committee. There was another Parliamentary inquiry in 1867, and in 1868 a Bill was introduced for amending the Metropolis Gas Act of 1860. This Act passed, and the Corporation acquired the power of purchasing by consent the undertakings of the gas companies supplying the City, a power which they never exercised. The companies on their part obtained power by this Act to amalgamate, and were compelled after two years to raise the illuminating value of their gas to 16 candles, and reduce the price to 3s. 8d. per 1,000 cubic feet, subject to going to the Board of Trade for a revision of price should it be necessary to maintain the dividends. In 1873 and 1874 the Imperial and Chartered Companies succeeded in establishing a claim for increase in price up to 5s., under the revision clauses of the Act of 1868, as the coal famine of the preceding years had caused a considerable increase in their working expenses. Up to 1870, the supply of gas to the metropolis was furnished by 13 companies, but between 1870 and 1876 six of these—the City of London, Great Central, Equitable, the Western, Imperial, and Independent—all amalgamated with the Chartered Company under the title of the Gas Light and Coke Company, and they, together with the Commercial Gas Company, now supply the whole of London north of the Thames.

At this time the South Metropolitan Gas Company was selling its gas at 3s per 1,000, and at the instigation of the City authorities an inquiry was held by a strong Parliamentary Committee, presided over by the late Right Hon. W. E. Forster, which occupied a month in 1875, and before which Mr. George Livesey gave evidence, and suggested identifying the interests of the consumers and the companies by an arrangement now known as the "sliding scale." The principle suggested was approved by the Board of Trade, and it was incorporated in the Acts obtained by the Gas Light and Coke and South Metropolitan Companies in 1876.

By the Gas Light and Coke Company's Act of 1876, the price of 16-candle gas was fixed at 3s. 9d. per 1,000, and the dividend at 10 per cent. which might be varied, subject to an increase or decrease in the price of gas, to be calculated as follows:—For every

penny or part of a penny charged in excess or diminution of the standard price the rate of dividend might be increased or diminished by 5s. per £100 per annum, this principle being known as the "sliding scale," and as at present the price of gas has been reduced by 8d., the dividend payable by the Company is 12 per cent. Provision was also made as to the application of excess of profits over the standard rate of dividend, and that all new capital should be sold by auction or tender, and this arrangement remains in force down to the present time, as the Gas Light and Coke Company's and other Gas Companies' Acts Amendment Act passed in 1880 only dealt with regulations of the supply of gas and its purity. The changes in the price of coal-gas supplied to the City will be found in the following Table:—

TABLE SHOWING THE PRICE OF GAS SUPPLIED TO THE CITY DURING THE UNDERMENTIONED YEARS:—

Year.	Rate per 1,000 cubic feet.	Year.	Rate per 1,000 cubic feet.	Year.	Rate per 1,000 cubic feet.
	s. d.		s. d.		s. d.
1826....	15 0	1855....	4 0	1875....	3 9
1834....	10 0	1856....	4 0	1876....	3 9
1837....	9 0	1857....	4 0	1877....	3 6
1838....	9 0	1858....	4 0	1878....	3 6
1839....	9 0	1859....	4 0	1879....	3 6
1840....	9 0	1860....	4 0	1880....	3 4
1841....	9 0	1861....	4 0	1881....	3 2
1842....	9 0	1862....	4 6	1882....	3 2
1843....	9 0	1863....	4 6	1883....	3 2
1844....	8 0	1864....	4 6	1884....	3 0
1845....	7 0	1865....	4 6	1885....	3 0
1846....	7 0	1866....	4 0	1886....	3 0
1847....	7 0	1867....	4 0	1887....	3 0
1848....	7 0	1868....	4 0	1888....	2 9
1849....	6 0	1869....	4 0	1889....	2 6
1850....	5 0	1870....	3 9	1890....	2 9
1851....	4 0	1871....	3 9	1891....	2 9
1852....	4 0	1872....	3 9	1892....	3 1
1853....	4 0	1873....	4 4	1893....	3 1
1854....	4 0	1874....	5 0	1894....	3 1

Having now traced the history of the City gas supply and the changes in price which it has undergone, we will turn to the gas itself, and see what variations have been taking place during the past 40 years in its illuminating power and composition. Ever since Bouguer

introduced the idea of expressing the illuminating power of illuminants as being of so many candles value this unit of light has been employed, and under certain defined conditions the London gas supply has to emit a light equal to 16 sperm candles of the size known as "sixes," and consuming the sperm at a rate of 120 grains per hour.

The amount of light emitted by a gas flame is entirely dependent upon the form of burner by which it is consumed; and the variations which have taken place in the standard burners employed for gas testing have given rise to the idea that the quality of gas supplied by the metropolitan companies is far higher than it was 40 years ago; but when we come to carefully examine into this subject, we find that this is purely fallacious.

Up to 1850, but little attention was paid to the illuminating value of the coal-gas supplied to the metropolis, but in that year a Bill was passed, which enacted that the light emitted by a brass Argand burner with 15 holes, consuming five cubic feet of gas per hour, should be equal to the light of 12 wax candles, of the size known as "sixes." These wax candles were, however, only equal in illuminating power to 10·3 of the sperm candles at present used for testing purposes, so that when, in 1860, an Act changed the illuminating power to 12 sperm candles, it meant an increase of 16·5 per cent. in the illuminating value of the gas; and, in 1868, this was again raised to 14 candles, and by the Act of 1876 this was increased to 16 candles, and remains so to the present time.

To the uninitiated, this gives the comforting reflection that, although the price of gas has been falling, we are being supplied with a quality which emits 55·3 per cent. more light than the gas sent out from the works in the years immediately following the passing of the Act of 1850; but when we examine the changes which have also taken place in the methods by which the gas has been consumed for testing purposes, we find that, although we have this large nominal increase in illuminating value, the actual light obtained by the consumer remains the same.

In 1864, the 15-hole brass Argand was discarded as a standard testing burner, and was replaced by a 15-hole steatite burner, which, by increasing the temperature of the flame, developed 11 per cent. more light; whilst in 1869 the "London Argand" 24-hole burner was introduced, and gave a still further increase in the light obtained from the gas,

amounting to over 17 per cent., and if we translate the light emitted from the gas sent out by the Chartered and Great Central Gas Companies in the years from 1852 to 1863, from terms of the old 15-hole brass burner, into the light which would have been emitted by the burner we use to-day, we find that the results are practically identical.

STANDARD BURNER.

Year.	Brass 15-hole	Steatite 15-hole	London
	Argand.	Argand.	Argand.
1854	12.72	—	16.39
1868	—	14.09	16.34
1894	—	—	16.60

And when leaving the photometric side of the question, we approach the purely chemical aspect, we find no change has taken place in the composition of the gas which would lead us to expect any great alteration in its illuminating value.

COMPOSITION OF GAS SUPPLIED TO THE CITY.

	1851.	1876.	1884.	1894.
Hydrogen	51.81	50.28	47.99	53.36
Saturated hydrocarbons	35.25	36.95	37.64	32.69
Unsaturated hydrocarbons	3.53	3.22	4.41	3.58
Carbon monoxide	8.95	4.37	3.75	7.05
Carbon dioxide	nil	nil	nil	0.61
Oxygen	0.08	0.22	0.26	0.21
Nitrogen	0.38	4.96	5.95	2.50
	100.00	100.00	100.00	100.00

Analysts—E. Frankland, Humphidge, P. Frankland, and Lewes.

On examining these analyses we see, however, a distinct change has taken place in the proportions in which certain constituents of the gas exist. The constituents of coal-gas may be divided into three classes:—(a) Those which give the illuminating properties to the flame; (b) the combustible diluents, which give size and body to the flame; (c) impurities which are generally as small in quantity as they can in practice be obtained.

In the above Table, the hydrocarbons, upon which the luminosity of the flame mostly depends, belong to the class which we term unsaturated hydrocarbons, whilst the combustible diluents consist of the saturated hydrocarbon methane, hydrogen, and carbon monoxide. On examining the analyses of the

Gas Light and Coke Company's gas made in 1884 by Dr. Percy Frankland, and one made this year by myself, it will be seen that the hydrogen is nearly 6 per cent. higher, the carbon monoxide over 3 per cent. higher, and the saturated hydrocarbons 5 per cent. lower than they were ten years ago, and although this has no practical effect upon the illuminating power, this change in composition has brought about a curious phenomenon with regard to the size of the flame.

A year ago my attention was called to the fact, that many consumers of gas within the City were noticing a considerable increase in their gas bills, with no corresponding increase in the number of burners in use, or in the hours during which the gas was consumed; and I was instructed by the Corporation Committee for County Purposes if possible to find the cause for this. In several cases there was nothing to give any clue as to the reason for this phenomenon, as the meters had been regularly tested, no alteration made in the number or form of burner used, and the gas had been consumed for exactly the same hours as before, and yet the consumption had been steadily increasing during the past three years.

After endeavours—for some time in vain—to find the cause of this, I at length made an extended series of experiments upon the composition of the gas and the height of flame which it yielded, and found that, up to three years ago, the flame emitted by a standard London Argand, when burning a 16-candle coal-gas, at the rate of five cubic feet an hour, was exactly three inches, but that since that time the height of flame necessary to emit that amount of light had been steadily growing less, and at the present moment a 16-candle flame in the London Argand has a height of only 2.6 inches.

The cause of this is that the height of a flame entirely depends upon the constituents of the gas, and whereas hydrogen gives an excessively short flame, methane, or marsh gas, will give a flame more than four times as long, when burning at an equal rate of flow, the flame yielded by carbon monoxide being intermediate in size between the two.

Height of flame yielded by gases burning at the rate of 5 cubic feet per hour in London Argand.

Gas.	Inches.
Hydrogen	0.985
Carbon monoxide	2.206
Methane	4.25

It is therefore evident that the alteration in composition, due to the increase in the

quantity of hydrogen and carbon monoxide, and the decrease in per-centage of methane, has led to this alteration in the size of the flame.

When a householder lights his gas burners, he invariably turns on the gas until he gets the largest possible flame without roaring or smoking, and, from the alteration in the composition of the gas which has taken place, this means using far larger quantities of gas than heretofore, so that, although an increase in illuminating power is obtained, a substantial increase in the quarter's gas bill is also found.

There are two causes for the alteration which has taken place in the composition of coal-gas, one of which is that in the metropolitan gas works it is now customary to use higher retort temperatures than were formerly employed, and this has tended to increase the per-centage of hydrogen in the gas not only supplied by the Gas Light and Coke Company, but also by the South Metropolitan and the Commercial Companies, as is shown in the following Table:—

Constituents.	South Metro- politan.	Gas Light and Coke Company.	Commercial
Hydrogen	52·22	53·36	52·06
Unsaturated hydro- carbons	3·47	3·58	3·24
Saturated hydro- carbons			
	34·76	32·69	34·20
Carbon monoxide..	4·23	7·05	4·75
Carbon dioxide ..	0·60	0·61	0·75
Nitrogen	4·23	2·50	4·10
Oxygen	0·49	0·21	0·00
	100·00	100·00	100·00

The second cause at present affects the gas supplied by the Gas Light and Coke Company alone, and is to be found in one of the methods of enrichment which they adopt.

In large towns like London, where the gas companies have to supply a gas of specific illuminating power, and the gas is continually subjected to photometric tests at stations spread over the whole area supplied—any deficiency in the lighting value of the gas being visited with rigorously enforced penal-

ties—enrichment, in some form or other, becomes a practical necessity. In London, the gas has to have an illuminating power of 16 candles; and in order to ensure this over the enormous area supplied, the gas must be sent from the works testing up to 17 to 17·5 candles. With seaborne Durham coals, of the character most largely used in the metropolis for gas making, the illuminating value of the gas will be about 15 candles, and the gas manager has to enrich the gas by from 2 to 2½ candles before he can with safety send it out for distribution. This enrichment is done in several ways: (a) by the admixture of a certain per-centage of cannel coal with the original gas-coal, (b) by carburetting the coal-gas with the vapours of volatile hydrocarbons, (c) by mixing the gas with carburetted water-gas.

Up to four years ago, the admixture of a certain per-centage of cannel coal with the Durham coal was the only method of enrichment employed by the metropolitan companies, and about that time the increase in price of cannel forced the companies to find some other process which should take its place, and the Gas Light and Coke Company tried experiments which led to their largely adopting carburetted water-gas for this purpose.

When steam acts upon carbon at a high temperature, the resulting action may be looked upon as giving a mixture of equal volumes of hydrogen and carbon monoxide, both of which are inflammable but non-luminous gases. The water-gas is then carburetted, *i.e.*, rendered luminous by passing it through heated chambers in which oils are decomposed by heat, and the mixture of oil-gas diluted with water-gas is made of such "richness" as to give an illuminating value of 24 or 25 candles, and this mixed with the poor coal-gas brings up its illuminating value to the required limit, and during the winter months the gas supplied in the City has mostly contained about 10 per cent. of the carburetted water-gas.

Carburetted water-gas burns with a short but very brilliant flame, far shorter than coal-gas, a 22-candle water-gas flame burning from a London Argand at the rate of 5 cubic feet an hour with a flame only 2½ inches in height, whilst a 16-candle flame of the gas supplied up to three years ago gave a flame 3 inches in height; and by an extended series of experiments I have been able to show that the coal-gas now supplied and enriched with the carburetted water-gas only gives a flame 2·6 inches in height, in order to emit a light of

16 candles, instead of 3 inches, as formerly was the case.

Under the Gas Companies' Acts, they are bound to supply a gas which, at the official testing stations, shall emit a light equal to 16 sperm candles, consuming 120 grains of sperm per hour, and as no Parliamentary restriction is placed upon the composition of the gas, the companies are perfectly within their rights in supplying gas of the kind now sent into the City, and the only remedy is to make it known to the gas consumers that if they desire their gas bills to remain at the same figure as before carburetted water-gas was used as an enricher, they must study the light emitted by the flame, and not its size.

The gas sent out by the Commercial and South Metropolitan, and also some portion of the Gas Light and Coke Company's gas, is not enriched by carburetted water-gas, but by charging it with the vapours of highly volatile hydrocarbons until the desired illuminating value is reached, and gas so enriched gives a flame of the same size as formerly, so that in the districts supplied with it, the increase in consumption has not been noticed. Statements have been made in the public Press, and I have also heard the opinion expressed by private individuals, that the gas companies send out gas which is far below the standard illuminating value. In order to do this, the companies would either have to have one set of mains to conduct gas to the consumer, and another set to supply the official testing stations, or else to specially carburet the gas close to the testing stations; a third supposition being that some of the trunk mains can have no official testing station attached to them near the points at which the distribution of the gas to the consumers commences. The first two theories would mean gross fraud on the part of the companies, which it would be absurd to seriously consider, and moreover would not be practicable, whilst the third supposes carelessness on the part of the authorities empowered to look after the gas supply of the metropolis, and I can assert from personal observation that none of these causes exist in the area of the City.

The gas companies are compelled by Act of Parliament to supply gas of a certain quality, and the gas referees, who have to decide upon the meaning of the Acts and the way in which they are to be carried out, evidently translate this as meaning that the gas is to be supplied to the area in which it is to be consumed, of the specified illuminating value.

Interpreting the Act in this light, the official testing stations are fixed in the City at the points where the great trunk mains deliver the gas to the districts to be supplied, and it is only under exceptional circumstances that the illuminating value of the gas is ever found to be below the required limit at these points.

In the big mains the gas is continually flowing at a fairly steady rate, and is neither exposed to any great alteration in temperature, nor from the size of the mains, to any very great amount of "skin friction," *i.e.*, rubbing of the gases against the sides of the pipes; but as soon as distribution commences, both these factors come into play, and as some of the chief illuminants of the gas are vapours and not permanent gases, lowering of temperature causes condensation of some of them, whilst the power which friction against the sides of the main service pipes, coated with deposited hydrocarbons, has of withdrawing the illuminants from the gas, still further decreases its light-giving value, whilst anywhere near the dead end of a service, stagnation in the gas during a large proportion of the 24 hours, when gas is not being consumed, adds still further to the trouble, and even at the testing stations, the influence of the small consumption of the gas on Sundays, and consequent stoppage in the manufacture on that day, can be traced in the illuminating value found on Monday morning.

The three official testing stations situated on the confines of the City area, at Kinghorn-street, Clothfair, at the Aldgate end of Fenchurch-street, and in Dorset-buildings, Salisbury-square, whilst my office in Guildhall-chambers, Basinghall-street, may be taken to represent the heart of the City.

The tests taken daily at my office are not official tests, because the office has not been certified by the gas referees, and, therefore, no legal action could be taken upon the results obtained, but as the *modus operandi* and the apparatus are the same as in an official testing station, the results are of equal value as showing the illuminating value of the gas, and the following results (Table, p. 426) of an average week's testing will give an idea of the effect which distribution has upon the illuminating value of the gas.

If the construction placed on the wording of the Act is correct, the gas companies more than fulfil their Parliamentary obligations as judged by the average of the years' supply, but if the illuminating value of the gas delivered to each individual consumer is to be a

minimum illuminating value of 16 candles, then the testing stations would have to be at the end of the service instead of the intake, and check tests would have to be taken with portable photometers on the consumers' premises.

Date. 1893.	Guildhall- chambers.	Fenchurch- street.	Clothfair.	Dorset- buildings.
Nov. 20, Monday	15'4	16'0	16'2	16'4
„ 21, Tuesday	15'3	16'3	17'0	16'6
„ 22, Wednesday ..	15'5	16'5	16'7	17'3
„ 23, Thursday	15'6	16'5	16'7	16'4
„ 24, Friday	16'0	16'8	16'6	16'8
„ 25, Saturday	16'2	16'9	17'2	17'1
Mean,	15'66	16'50	16'66	16'76

Mean of the three official testing stations, 16'64.

Whilst, however, the public strains at a gnat, and feels injured if the illuminating value of the gas falls to the slightest extent below the standard, they swallow the camel with the greatest suavity, and consume the gas supplied to them by methods of the crudest and most wasteful description.

Of all the many questions which at the present time affect the coal-gas industry, there is probably none of more importance than the method by which gas is consumed. The companies in London are tied down by the Legislature to supply gas of an illuminating power of 16 candles; and when we come to consider what this in reality means, we find that, by one of those subtle strokes of humour in which our legislative body occasionally indulges, it means to the consumer almost anything 'except a light equal to 16 candles. The amount of illumination which can be obtained by the consumption of coal-gas is entirely dependent upon the method by which the gas is burned. From a so-called 16-candle coal-gas the consumer rarely obtains a value of more than 12 candles per 5 cubic feet of gas consumed; while by using burners of rational construction, upwards of 40-candle illuminating power could be obtained for the same consumption of gas.

The light emitted by a coal-gas flame is entirely dependent upon its temperature, and flat flame burners, exposing a thin sheet of flame to the cooling action of the air, give the worst results. Argand burners are better, as

the cooling is not so great, whilst the regenerative burners lately introduced, by utilising the heat of the products of combustion for raising the temperature of the gas and air supplied to the flame, give an enormous increase in the light emitted.

If the gas companies could only get an Act passed authorising the use of a regenerative burner as the standard, there is no reason why they should not call the gas at present supplied 40-candle gas, the consumer, however, using the flat flame burner, would still be only obtaining the light he did in 1850. Incandescent mantle burners, which act on a totally different principle, also yield a high illuminating value.

On carefully testing the burners in ordinary use, we find that, for an equal consumption of gas, the results at once show the enormous advantage to be obtained by regeneration, and also how serious is the loss which attends the employment of ordinary burners:—

Light obtained per cubic foot of 16-candle gas consumed.

Burner.	Candle units.
Regenerative and incandescent	7 to 10'00
Standard Argand	3'20
Ordinary „	2'90
Flat flame No. 7	2'44
„ No. 6	2'15
„ No. 5	1'87
„ No. 4	1'74
„ No. 3	1'63
„ No. 2	1'22
„ No. 1	0'85
„ No. 0	0'59

These burners were by well-known makers; but there are plenty of cheap German nipples in the market which will give even worse results. In the above Table, No. 7 is the largest flat flame burner given, as any larger size would never be used for indoor illumination, but with some of the big flat flame burners employed for outdoor work, as much as 3 candle-power per cubic foot of gas is developed by the best make, while it is also quite possible to find cheap imitations of them, which can scarcely be distinguished by their appearance, only developing a little more than one candle per cubic foot. It seems probable that 10 candle units represent the maximum light to be obtained in practice per cubic foot from the so-called 16-candle coal-gas, as, although greater regeneration will increase it as high as 16 units, the heat is so intense that the burner is quickly destroyed. Taking 10 candle units as being the maximum amount of light for a consump-

tion of one cubic foot of gas per hour, we can now form an approximate idea of the waste of illumination which attends the ordinary methods of burning the gas.

If the burners most commonly in use in houses be examined, they will be found to consist chiefly of No. 4 and No. 5 flat flame nipples; and I do not think I should be over-estimating the number in use if I put them at 85 per cent. of the total. The remaining 15 per cent. is made up of larger flat flame burners, Argands, and regenerative lamps, which give a higher service; but it will be found that the total value obtained will not exceed 2·5 candles per cubic foot. This means that 75 per cent. of the total value obtainable from the gas is wasted, and that for our present expenditure in coal-gas we could obtain four times as much light.

In the middle of January this year, the *Daily News* published an article on the quality and testing of London coal-gas, in which a proposition was first made public, that unenriched coal-gas should be supplied to the consumer at a lower rate than is at present charged for the enriched 16-candle gas, and this question is of such interest and importance to both consumer and gas company that any paper dealing with the present status of our gas supply would be incomplete without taking this question into consideration.

As before stated, the coal-gas as made from Durham coal at the temperatures employed in the metropolitan gas works has an illuminating value of from 14 to 15 candles, and the enrichment of this gas up to the required value costs far more pro rata than the amount of light obtained from the unenriched gas.

This cost has entirely to be borne by the consumers, and the whole practical question to be decided resolves itself into this:—"Is the game worth the extra candle and a-half?"

If coal-gas were used for illuminating purposes only, I believe the consumer would be a considerable gainer by having the unenriched gas supplied at a lower price, and when we consider the amount of gas used as a fuel, and that the quantity so employed is daily increasing, the cost of enriched gas becomes of the greatest importance. One of our greatest authorities on coal-gas has computed the value of one candle in illuminating power in the gas supplied to London at £200,000, and if his calculation be correct, the consumers in the metropolis would be saved about £300,000 a year by using unenriched coal-gas, and I venture to say that not one of them would

notice the slightest difference in the light emitted by the gas in the burners ordinarily in use, whilst with regenerative burners the difference would be still less.

My reasons for this statement are as follows. I have already shown that the flat flame burners, although convenient and easily fitted, only develop a very small proportion of the light obtainable from the gas, and on testing No. 4 and No. 5 flat flame jets with 16 and with 14·5 candle gas respectively, there is practically hardly any difference in the light emitted. It will take years to educate the consumer sufficiently in the methods of burning coal-gas to cause the flat flame burner to be generally discarded, and during this period he will be no sufferer by the change, whilst with the regenerative and incandescent burners which will eventually take the place of the flat flame any difference will disappear.

In the regenerative burner the increase in illuminating value is almost entirely due to the rise in temperature causing methane, which forms about 34 per cent. of the coal-gas by volume, to become a very valuable illuminant, and as there is just as much or more methane in the unenriched gas, it is manifest that this increase will still be found.

In the incandescent burner, the coal-gas is burnt in an atmospheric burner, and the non-luminous flame is made to heat a mantle of refractory material up to incandescence, and for this purpose the 14·5 candle gas will do as well as the 16.

I have also shown that, in the distribution of coal-gas, a 16-candle gas loses some of its value by condensation and the skin friction which it encounters in the small and exposed pipes; and one argument which has been raised against the lowering of the standard is, that if a 16-candle gas is reduced to 15 candles during distribution, a 14½-candle gas will be lowered to 13½. This, I think, is a mistake. An enriched gas is lowered in illuminating value, because certain vapours are condensed from it; but it will be found that, with an unenriched gas made at a high temperature, this action is decreased to a minimum, on account of the small proportion of vapours present.

It is to the interest of the gas consumer and gas company alike that the price of gas should be reduced to the lowest possible figure, and it seems to me that the possibility of reduction in price is dependent upon the discarding of the costly enrichment.

In concluding this account of the present condition of the London gas supply, I can only

say, that in no city in the world is the purity and illuminating value of the gas more rigorously looked after than in London, and in no city in the world do the gas companies more loyally strive to fulfil all the obligations placed upon them.

DISCUSSION.

A MEMBER asked how it was that the nitrogen had so much increased in recent years, as compared with 1851, when it was only '38 per cent.?

Dr. W. ANDERSON, F.R.S., said it was remarkable how slow the public were to realise the fact that their grumbling against the quality of the gas ought really to be transferred to the burners. In his own house he found that, by simply putting in rational burners, the gas, which had formerly been complained of, was quite satisfactory. He should like to know by what means the Edinburgh gas was brought up to such a high value as 22 candles or upwards?

Mr. C. C. CARPENTER said there was one point on which he should like a little explanation and that was the per-centages of oxygen and carbonic acid, especially the latter, shown by the analyses. Did Professor Lewes consider it possible, with such a high per-centage of carbonic acid as $\frac{3}{4}$, to purify gas from sulphur compounds on the present system; and how was it that so large a per-centage could run the gauntlet of the lime boxes, which had so great an affinity for carbonic acid? The same remark applied to the oxygen. There was a considerable amount of sulphide of calcium in the lime boxes, and of sulphide of iron in the oxide boxes, both of which had an attraction for oxygen, and he could not understand how so much managed to get through. In 1851, 1876, and 1884 there appeared to be no carbonic acid in London gas at all; and nearly all purification in London was still done by means of lime, less oxide being used now than formerly; but, despite that, the per-centage in the Chartered Gas Company's gas had gone up to '61.

Mr. J. WEST said the public were, as a rule, very ignorant on the points brought forward in this paper, and they were much indebted to Professor Lewes for emphasizing them. Some twenty years ago, when he read a paper on a similar subject, it was supposed that gas engineers were against improvement, and the question was asked "Can any good thing come out of Nazareth?" But he took it that improvements were as much to the benefit of gas companies as of consumers. It was well known to all gas engineers that the gas they made was not properly consumed, owing mainly to defective burners, and it was a great pity to have a good thing spoiled by bad usage, just as it was to have a good joint badly cooked. If the public would spend a few shillings on proper burners, they would get the value

from the gas which had been indicated. A few years ago, when reading a paper in Manchester, on this subject, he selected a number of burners from the public thoroughfares, and put them side by side with some of the most scientific burners made, and he was even surprised himself to find what poor burners were in use; many of them were not giving more than 25 per cent. of the light the gas was capable of yielding. All gas engineers desired was to have this subject talked about and considered. He believed the electric light had stirred them up a bit, and that it would be imperative on them to do a little more themselves in this direction than they had done. As a rule, the complaints they received were caused by bad burners or defective supply. A very important point was the regulation at the point of ignition, and he recommended that all burners should have a regulator attached to them. He understood that at the regular stations in London the gas showed an average of $16\frac{1}{2}$ candles, but that where Professor Lewes tested it, it did not reach that standard, and he should like to have that explained. He once had a similar experience in a large city, where, at the legitimate testing stations, the gas had its full illuminating power, it being tested there on a live main where the bulk of the gas was on its way to the consumer; but in the same city other gentlemen could not get anything like the illuminating power he obtained. It was afterwards found that in the place where they got a bad record the mains were very stagnant, there was no gas passing through them, and the services were small; and he did not consider that such a place was proper for testing. There had been attempts, he held, to test at "dead ends" and that sort of thing, but he did not think that was what the Act of Parliament intended.

Mr. FRANK LIVESEY congratulated Professor Lewes on his boldness in bringing forward, at what he called a meeting of consumers, a proposition to reduce the quality of gas, because, in all probability, the general opinion would be against him, but, at the same time, he desired to support this view for the following reasons:—Gas companies had two keen competitors, the electric light, which was used by the rich, and petroleum, which was used by the poorer classes, and was now sold at 4d. a gallon. The prosperity and even existence of gas companies now depended on their supplying cheap gas, which was wanted in a great city not only for lighting but for other purposes. The late Sir William Siemens advocated a dual supply, one for lighting, and the other for heating and motive power; but now that the streets of large cities were so crowded with gas and water pipes, telephone and electric wires, it was quite impracticable to consider that at all; there must be one system of mains only. If there were a lower quality of gas no one would suffer much who wanted it for lighting, and those who used it for heating and cooking would gain. If enrichment could be done away with, the price could be reduced, and if it could be

brought down to 2s. 2d. or 2s. the demand would be enormous; and the smoke nuisance in towns might be largely reduced. Gas companies were now supplying the poorer classes with coin meters, the demand for which was very great. He knew a case where a poor woman and her children, not properly clothed, burned gas during the intensely cold weather in January to keep them warm; they could find pennies to put in the meter, but they could not find enough money to buy coals. In one of these meters the sum of 10s. was found, which had been put there in a comparatively short time. Cooking by gas was not always economical: for instance if a kettle was left boiling away for hours, or if the stove was left burning all night; but that sort of thing did not happen to poor people; and if gas were more used in cooking a large amount of the smoke nuisance would be done away with, because it was the large number of small chimneys which did the mischief. If gas might be supplied as made from Durham coal without enrichment the price could be reduced and the supply would be more regular. To be sure of escaping penalties, the company often sent out gas of 18-candle power, and this was not so well suited to the burners and caused a smoky flame. Fifteen-candle gas would not diminish in quality so much between the works and the point of consumption. Whenever a gas company proposed anything the public thought they wanted to take some advantage of them, but that was not so at all, they wanted to be able to supply cheaper gas and to avoid being brought up at the police-court, in company with criminals, and fined. Unfortunately, good burners were expensive, but he held if Professor Lewes turned his attention to the flat-flame burners he would find it possible to greatly improve them; indeed, it had been done to some extent already. The flame wanted to burn under a higher temperature, and to have the supply of air regulated. If the gas came out at its full flow you could not get all the light out of it. One burner-maker had one in which a large burner was put on the top of a small one, so that the gas issued at a slow speed, and this gave much increased light.

Mr. O'DRISCOLL, M.P., asked if Professor Lewes could give some information as to the comparative cost of regenerative incandescent and ordinary flat-flamed burners, both as to first cost and maintenance, and also say whether the deleterious effects of burning gas on pictures, books, &c., were much reduced by the use of improved burners.

Mr. G. T. BEILBY said he came from the North, where gas was managed somewhat differently, but he had been much interested in the paper, and especially in the suggestion that the illuminating power should be reduced, his firm opinion being that in consequence of the competition of electricity a change in the opposite direction was more likely to be pressed for. He understood the reasons given for the proposed change were three — the

excessive cost of enrichment; that this expensive enrichment was to a great extent lost in the passage of the gas through the mains and pipes; and that the consumer used gas so badly when it reached him that the difference of two candles would not be practically noticed. These were certainly very strong grounds, but he should like to give one or two reasons for dissenting from them. No detailed figures as to cost of enrichment had been given by Professor Lewes, but Mr. Livesey had suggested a possible reduction to 2s. or 2s. 2d., if enrichment were given up; this put the cost of enrichment at 3d. or 4d. per candle. Now, certainly, gas was being enriched by means of oil in the North, at $\frac{1}{2}$ d. per candle per 1,000, in a thoroughly practical way. At this rate the total cost of enriching London gas to the present standard would only be $1\frac{1}{2}$ d. per 1,000 feet. The difficulty as to the loss of illuminating power in the mains had been overcome by a special way of gasifying the oil, by which it was converted into a perfect gas, and little or no condensation took place afterwards. The gas, as delivered, was as permanent as the natural gas before enrichment. On the third point he could only speak in a very general way, but to consume gas economically in flat-flame, burners which were the only ones practicable, was to a large extent a question of pressure. With gas of high illuminating power you might safely use higher pressure at the burner, without unduly lowering the illuminating power. He was glad to hear Mr. Livesey refer to improvement of the flat-flamed burner, for they could not afford to throw it aside. Those who had had experience with regenerative and incandescent burners knew how unfit they were for use in ordinary houses of the poorer class; they easily got out of order, required frequent attention by a skilled person, and their cost was too high.

Mr. C. GANDON agreed with Professor Lewes that it was a mistake to endeavour to produce gas of high illuminating power in the metropolis. In Scotland, where they were in the region of the cannel coalfields, it was a different question altogether. In the interest of both consumers and gas companies it would be better to have gas which could be made from Durham coal without any enrichment. Professor Lewes said 15-candle gas could be made from such coal, but he did not think that could be taken as the minimum, because it was liable at times to go below. He thought no restrictions should be placed on the companies by Parliament, but they should be left free to produce the best gas they could and at the cheapest price. There was no restriction laid down as to the amount of moisture which a baker might have in a loaf of bread, and he thought all these vexatious limits worked injuriously.

Mr. BOTLY thought hardly any gas engineer would controvert what had been said as to the desirability of educating gas consumers in the proper

use of the material supplied to them, and most engineers had endeavoured to furnish information by circulars and in other ways. But though much improvement had been made of late years in the utilisation of gas, still very often information proffered by gas companies was looked upon with suspicion. Of course, gas companies, like all other traders, desired to give satisfaction to their customers, in order to increase their business. If the public would only pay a little more attention to what they were told, many complaints would disappear. A great point was to have a great pressure up to the point of ignition, and there to regulate it, so as to maintain a steady flame, and get the maximum light. One point not yet touched upon was the shape of the globes; the old-fashioned shape, with a narrow bottom, acted as a chimney, and distorted the flame. A globe with a wide opening, which simply protected the flame from side draughts, allowed the maximum light to be obtained even from flat flame burners. He was not surprised to see the quantity of carbon dioxide, after hearing the quantity of water-gas used, and knowing the difficulty there was formerly in getting rid of the large amount of carbonic acid produced in that way, but on hearing what followed, he thought he must be mistaken in that view. He thought it would be well to lower the illuminating power, but whenever a company went to Parliament, the struggle always was to increase it further; and he rather doubted whether a lowering would not increase the trouble some companies had with naphthaline.

Mr. PRICE asked if the results given with the flat-flame burners were arrived at by passing the gas through them at such a rate as would give the best results, or at what might be called the ordinary rates. He had found, on testing flat-flame burners which were supposed to be burning 4 feet an hour, that they were really passing 10 or 12 feet, and when the flow was reduced to about one-third, the improvement in the light was very noticeable.

Lieut.-Col. ALLAN CUNNINGHAM, R.E., said he gathered from the paper that the enrichment of gas up to the legal limit was very expensive, and was not really worth the extra candle or so it produced; and that the one thing consumers ought to do was to look after their burners. The gas companies might, he thought, do something in that direction, but in his own experience he could not remember their ever having done so. He should like to know how it was that sulphur was not mentioned as a constituent of the gas in any of the analyses. It was stated that there was not much change in the constituents of gas during the last forty years, but he noticed that though there was not much change in the two principal ingredients, hydrogen and saturated hydrocarbons, there was a considerable change in some of the minor constituents. Nitrogen, which was of no use, had increased from only .3 per cent. up to .6 per cent.; carbonic dioxide from nothing

up to .6 per cent.; and oxygen from .1 to about .3 per cent.

Professor LEWES said the carbonic monoxide had merely risen in the last analyses because of the addition of 10 per cent. of carburetted water-gas, of which the carbonic monoxide was a constituent; it had no illuminating power, but acted as a carrier for the oil-gas mixed with it.

Colonel CUNNINGHAM said he was glad of that; he was going to speak against the advisability of increasing the carbon monoxide, because it was very poisonous, and being non-odorous was not perceptible like ordinary coal-gas by the smell, and was therefore all the more dangerous.

Prof. LEWES, in reply, said the increase in nitrogen since 1851, when it was only .38 per cent., was due chiefly to the use of clay retorts instead of iron, which were more easily cracked, and thus allowed air to get in. Another reason was that in most works now a small quantity of air was mixed with the gas for purification purposes, which added to the nitrogen which got in through leakages. The high quality of the gas in Edinburgh was due to the fact that in the North cannel coal was easily obtained, and it was used in larger quantities than it could be in London, where the cost of carriage was prohibitive. Mr. Carpenter raised a point of some interest and importance when he asked how it was there was no carbonic acid in the analyses until 1894, and then there was from $\frac{1}{4}$ to $\frac{3}{4}$ per cent. The fact was it was not there now, but in applying the present process of analysis to enriched gas you always found carbonic acid, although it was not there. The reason was that the absorbent used to detect it had the power also of absorbing minute traces of the enrichers which had been put in, and these got recorded as carbonic dioxide. He was at present trying to find out an absorbent which would be free from this objection, which attached to the use of sodic or potassic hydrate. With regard to Mr. West's remarks, there was not a gas manager in the kingdom who would not support him in his contention that gas should only be tested at the large mains; the trouble always commenced with the distribution through the smaller pipes, and the diminution shown in the testing at the Guildhall-chambers was due to that cause. Mr. Livesey's observations were very important, and the reasons he gave for cheapening gas, by doing away with the extra $1\frac{1}{2}$ candle, ought to be very carefully weighed. He believed the effect of the competition of the electric light in the future would be to establish gas in an absolutely unassailable condition as the fuel of the people, and anything which could be done to cheapen the price of gas, and so hasten that day, would confer an immense benefit on the dwellers in big cities. In London, there were 6,000,000 tons of bituminous coal burned every year, and no matter how perfect the stoves were—and 99 per cent. of them were very

bad—whenever fresh coal was put on, large quantities of smoke and oily matters were distilled out of it, and contaminated the air. It was the use of bituminous coal which made London fog what it was, and made it so lasting. The hydrocarbon vapours from the coal, by coating the little particles of mist, caused them to linger much longer than they would otherwise. About forty years ago Dr. Frankland made an experiment, which had not received sufficient attention. He took two evaporating basins, put into them equal weights of distilled water, and blew on the surface of one a small quantity of coal smoke; he then placed both under the same glass jar, in which there was some sulphuric acid to keep the air dry, and he found that the length of time taken to evaporate the water on which he had put a film of smoke was 80 per cent. greater than in the other case. A country mist was all dissipated by about 11 o'clock in the morning by the sun, but no 11 o'clock sun would get rid of a genuine London fog; when once formed it was there to stay, sometimes two or three days. The more the use of gaseous fuel was adopted the nearer would be the time when London fogs would be cleansed and altered in character. With regard to the relative cost of different burners compared to the light they gave, he gave a lecture before the Gas Institute, some time ago, which included such a table, but he had not the figures with him, and the matter was too complex to attempt to give them from memory. Mr. Beilby remarked that 26-candle gas could be burned at far higher pressure than common gas, which was quite true, and also that the flat-flame burner could be improved, but he doubted if you could ever get from it an amount of light which would come near that from an incandescent or regenerative burner. In a flat flame there was a large portion at the base which was non-luminous, and that became less and less the richer the gas you used. The light depended on the rate at which the flame was heated up to the temperature at which certain chemical interactions took place; the flame must be from $1,000^{\circ}$ to $1,200^{\circ}$ C before it was properly luminous. The richer the gas was in hydrocarbons the sooner would that point be reached, and that was why with a rich gas the non-luminous portion was smaller. Mr. Beilby spoke with some disrespect of the regenerative and incandescent burners, and he did not wonder at it, because rich gas, such as he was accustomed to, was not suited to such burners; they had to be very carefully regulated indeed to prevent smoking, but though he should not recommend regenerative burners for Edinburgh he should for London; especially as if properly employed they furnished the most effectual means of ventilation. Although incandescent lights were very beautiful, still, a room with a large number of people in it, would have the air much purer with properly ventilated regenerative burners. He had been in Edinburgh several times and had not been particularly struck with the illumination of the streets. The end

of Regent-street, or Parliament-street, where there was a large mass of lamps showed a much finer effect than any he saw in Edinburgh, though London gas was only 16-candles and Edinburgh was 26; and in those parts of Paris where gas was used on a large scale the illuminating effect was as good as, if not better than in London, though the Paris gas was only 14-candles. As the illuminating power increased you had to decrease the size of the burner, and burning rich gas in a smaller burner never gave as good an effect in open spaces as burning poorer gas in a larger burner. Mr. Botley was quite right about the globes, but the public were, he thought, learning that lesson. It was not the public who required to be educated so much as the gasfitter, in whose hands the householder practically was; but as a rule there was no one who knew less about coal-gas, or the method of consuming it, than the gasfitter. A question was asked why sulphur was not mentioned in the analysis, it was simply because the whole quantity present was so small that it would be impossible to represent it in such an analysis unless you went to about five places of decimals, and as few gas analyses were correct to one place, it would be simply waste of time. The sulphur in London gas was really brought down to a minimum.

The CHAIRMAN, in proposing a vote of thanks to Professor Lewes, said he believed that in the future gas would be used more for motive-power and heating purposes than for lighting. He had an electric installation in his own house, but his gas bill was more than it used to be, gas being used as a means of producing electricity.

The vote of thanks was passed unanimously, and the meeting adjourned.

General Notes.

LYONS EXHIBITION.—It is announced, in the last number of the *Board of Trade Journal*, that an International Exhibition will be opened at Lyons on the 26th April. The Exhibition will be under the patronage of the Minister of Commerce.

FOOD EXHIBITIONS.—An International Exhibition will be held in Vienna from 20th April to 10th June, and an Exhibition of viticulture and agricultural machinery will be held at Milan in May. An Exhibition of Swedish cheeses has lately been held at Stockholm, which was organised with the object of giving encouragement to this branch of the Swedish dairy industry. The promoters are anxious to create a Swedish export trade in cheeses with England.

LECTURES ON METEOROLOGY.—A series of lectures on "Meteorology in Relation to Hygiene" has been arranged by the Royal Meteorological Society and the Sanitary Institute to be delivered at the Parkes Museum, 74A, Margaret-street,

Regent-street, W., on the following Mondays and Thursdays, at 8.30 p.m.:—April 23, G. J. Symons, F.R.S., "Instruments and Observations and their Representation." April 26, Dr. H. R. Mill, F.R.S.E., "Temperature of Air, Soil, and Water." April 30, R. H. Scott, M.A., F.R.S., "Barometric Conditions and Air Movements." May 3, W. Marriott, F.R.Met.Soc., "Moisture: its Determination and Measurement." May 7, C. Theodore Williams, M.A., M.D., F.R.C.P., "Climate in Relation to Health, and Geographical Distribution of Disease." May 10, F. Gaster, F.R.Met.Soc., "Fog, Clouds, and Sunshine."

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

APRIL 18.—"Design in Modern Carpets."
By ALEXANDER MILLAR. HUGH STANNUS, F.R.I.B.A., will preside.

FOREIGN AND COLONIAL SECTION.

At Eight o'clock:—

APRIL 19 (THURSDAY).—"Tasmania and the forthcoming Hobart International Exhibition, 1894-95." By G. COLLINS LEVEY, C.M.G. SIR ROBERT HERBERT, G.C.B., Agent-General for Tasmania, will preside.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

CAPTAIN W. DE W. ABNEY, C.B., F.R.S., "Photometry." Three Lectures.

LECTURE III.—APRIL 16.—Applications of Photometry to various scientific purposes.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 16...SOCIETY OF ARTS, 8 p.m. (Cantor Lectures.) Captain W. de W. Abney, "Photometry." (Lecture III.)

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. H. de Mosenthal, "The Treatment of Gold Ore at the Witwatersrand (Transvaal) Goldfields." 2. Mr. F. Platten, "Note on Modification of Ferric Chloride Distillation Process for Estimation of Arsenic in Copper." Surveyors, 12, Great George-street, S.W., 8 p.m. Adjourned Discussion on Mr. Howard Martin's paper, "The Report of the Local Government and Taxation Committee of the London County Council on the subject of the Rating of Ground Values."

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Paper on "The Religion of the Assyrians and Babylonians."

TUESDAY, APRIL 17...Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. A. Fleming, "Electric Illumination." (Lecture III.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. Leveson Francis Vernon Harcourt, "The Training of Rivers." 2. Mr. Henri Léon Partiot, "Estuaries."

Statistical Geological Museum, Jermyn-street, S.W., 7½ p.m. Mr. J. A. Baines, "The Conditions and Prospects of Popular Education in India."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Prof. Karl von Bardeleben, "The Bones and Muscles of the Mammalian Hand and Foot." 2. Dr. G. Herbert Fowler, "Two New Species of Sea-Pens of the family *Veretillidae* from the Madras Museum." 3. Mr. F. E. Beddard, "Two new Genera, comprising three new Species of Earth-worms from Western Tropical Africa."

WEDNESDAY, APRIL 18...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Alexander Miller, "Design in Modern Carpets."

Meteorological, 25, Great George-street, S.W., 8 p.m. 1. Mr. R. Inwards (President), "Some Phenomena of the Upper Air." 2. Exhibition of Meteorological Instruments and Photographs.

Microscopical, 20, Hanover-square, W., 8 p.m. Dr. A. M. Edwards, "Eocene deposit of Diatomaceæ. Origin of a fossil lake in New Jersey, and the identification of it by the Diatoms found in the deposits."

Archæological Association, 32, Sackville-st., W., 8 p.m.

THURSDAY, APRIL 19...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Foreign and Colonial Section.) Mr. G. Collins Levey, "Tasmania and the Forthcoming Hobart International Exhibition, 1894-95."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. Prof. Graf. Solius-Laubach, "A Monograph of the Acetabulariæ."

Chemical, Burlington-house, W., 8 p.m. 1. Messrs. G. J. Burch and J. W. Dodgson, "Action of Metals on Strong Acids." 2. Dr. A. Richardson, "Action of Light on Oxalic Acid." 3. Mr. H. Pears, junior, "English Jute Fibre, II." 4. Mr. C. Smith, "Natural Oxycelluloses."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. F. Bridge, "Music." (Lecture I., Musical Gesture.)

Historical, 20, Hanover-square, W., 8½ p.m. Prof. T. F. Tout, "The Earldoms under Edward I."

Mechanical Engineers, 25, Great George-street, 7½ p.m. 1. Inaugural Address by the President, Prof. A. B. W. Kennedy. 2. Mr. E. W. Anderson, "Description of the Grafton High-Speed Steam-engine."

Numismatic, 22, Albemarle-street, W., 7 p.m.

Camera Club, Charing-cross-road, W.C., 8 p.m. Prof. F. Cheshire, "The Correlation of the Mouths of Insects to the Mouths of Flowers."

FRIDAY, APRIL 20...United Service Institution, Whitehall-yard, 3 p.m. Lieut.-Colonel J. L. B. Templer, "Steam Transport on Roads."

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Dr. J. G. Garson, "Early British Races."

Civil Engineers, 25, Great George-street, S.W., 7½ p.m. (Students' Meeting.) Mr. Henry T. White, "The Sinking by Compressed Air of the Cylinder-Foundations of the Trent viaduct."

Mechanical Engineers, 25, Gt. George-street, S.W., 7½ p.m. Mr. David Joy, "Description of a Fluid-pressure Reversing Gear for Locomotive Engines."

Queckett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, APRIL 21...Royal Institution, Albemarle-street, W., 3 p.m. Mr. H. D. Traill, "Literature and Journalism."

Journal of the Society of Arts.

No. 2,161. VOL. XLII.

FRIDAY, APRIL 20, 1894.

*All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.***Chicago Exhibition, 1893.****OFFICIAL LIST OF AWARDS.**

With the present number of the *Journal* is issued a Supplement, containing the official list of the awards for Great Britain and for India.

The Colonial awards have been sent direct to the Colonial Commissioners.

The list is issued as received from America. In many instances it appears to differ from the lists issued from time to time at Chicago, as the awards were made by the judges.

Many of the entries refer to exhibits which did not form part of the British Section.

Each award consists of a bronze medal and a diploma. All awards are of equal value. The medals and diplomas will be forwarded to the exhibitors as soon as they are received by the Royal Commission. It is not anticipated that they can be ready for issue for a long time to come.

According to the latest advices from America, the design for the medal has not been finally decided upon, but a promise has been given that a representation of the medal shall be sent to the Secretary as soon as one can be obtained.

Notices.**CANTOR LECTURES.**

Captain W. DE W. ABNEY, C.B., F.R.S., delivered the third and concluding lecture of his course of Cantor Lectures on "Photometry" on Monday evening, 16th inst.

The CHAIRMAN (Mr. Francis Cobb) proposed a vote of thanks to Captain Abney for his valuable course of lectures, which was carried unanimously.

The lectures will be printed in the *Journal* during the summer recess.

Proceedings of the Society.**APPLIED ART SECTION.**

Tuesday, April 10, 1894; SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., in the chair. The paper read was "Evolution of Decorative Art," by Henry Balfour, M.A.

The paper and discussion will be printed in the next number of the *Journal*.

EIGHTEENTH ORDINARY MEETING.

Wednesday, April 18, 1894; HUGH STANNUS, F.R.I.B.A., in the chair.

The following candidates were proposed for election as members of the Society:—

Franklin, George Edward, Rickmansworth, Herts.
Kralls, Carl, 289 and 291, Regent-street, W.
Osborne, James, 30, St. Swithin's-lane, E.C.
Toleman, Richard James, 17, Goswell-road, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Aldridge, Rev. Robert, 27, Westfield-road, Edgbaston, Birmingham.
Bower, James, 8, Vernon-gardens, Gateshead-on-Tyne.
Evans, Joseph, Guildhall, Grantham, and 3, Barrowby-road, Grantham.
Grove, William, 63, Baker-street, W.
Hawkins, Isaac Thomas, Vale-house, Somerton, Somerset.
Hertslet, Edward Cecil, Elm-house, St. Julian's Farm-road, West Norwood, S.E.
Oldham, Charles F., The Shiel, Weybridge, Surrey.
Orloff, Prof. Nicholas, 20, Finborough-road, West Brompton, S.W.
Partington, Miss Jessie, 16, Pembridge-square, W.
Treble, Charles F., 20, Queen's-parade, Clapham-junction, S.W.

The paper read was—

DESIGN IN MODERN CARPETS.

BY ALEXANDER MILLAR.

I am very glad to have the opportunity of bringing before you the subject of design as applied to carpets, and I hope the fact that the Society of Arts has thought it worthy of a place in its programme will be the means of securing for it the attention of many who have hitherto ignored it. As a member of a carpet manufacturing firm I may perhaps be pardoned for saying that it has received less attention than it deserves.

I propose to deal, not with the great masterpieces of the East, but with carpets as they are

produced in Great Britain at the present day, to point out the influences which make them what they are, and to suggest some means by which those that have an evil tendency may be counteracted, and free play given to those which make for good.

Chief among the influences of harmful tendency are the indifference and neglect with which the subject is treated by those who might naturally be expected to bring an improving influence to bear upon it. Those who form and guide public taste, whether as designers or as critics, have, as a rule, by common consent, let carpets severely alone.

In the case of designers, this arises mainly, I believe, from ignorance of technical requirements, or from their being repelled by the apparently cramping nature of those requirements, on a first superficial view. I cannot say whether the technique is more difficult of comprehension than in the case of other fabrics. To one familiar with its conditions they do not seem very formidable, but it would seem that to outsiders they have a different aspect. A writer in this month's *Fortnightly Review*, says: "Designing for carpets seems to be a specially difficult task, and one that requires the greatest amount of practical training and knowledge." Whether this be so or not, I have known many cases in which designers of great ability in other branches of decorative art have entirely failed to get their ideas for carpets into practical working shape, and, finding themselves at every turn cramped and fettered by the inevitable conditions of the fabric, they have given up the attempt in disgust, and in some cases, I fear, have laid the blame of their failure at the door of the manufacturer. The same artist who can make a wall-paper design capable of being reproduced almost in *fac-simile*—so fully does it comply with manufacturing conditions—when he attempts to design a carpet will either produce something which cannot be carried out at all, or which, when reduced to the inevitable ruled paper, will have lost any merit it originally possessed.

Now, this must be his own fault. For trained carpet designers, whatever their failings may be, feel, as a rule, little, if at all trammelled by the limitations which others find so irksome. To work within them becomes a second nature, and when they are felt, the devising of means of evading or surmounting them is quite a source of pleasure, and tends towards the development of a style characteristic of the fabric.

This has been done supremely well, once for all, by the unknown geniuses who invented or developed the leading types which run through the whole range of Eastern carpets, and who have thereby shown that, within the limitations imposed by the fabric, it has been possible to produce works which are among the greatest triumphs of textile art that the world has produced. This being so, it is evident that it is not the conditions which stand in the way, but the failure of the artist to submit himself to those conditions. It may be said that Eastern carpets, by their freedom from mechanical repetition, give much more scope for the designer than modern fabrics, but to this there are two replies. First, there are several kinds of carpets made in this country which, if necessary—that is if expense be no object—can be made equally free from repetition, and which are quite unlimited in range of colour. Secondly, it is not because of want of scope that these artists have failed, but because it has been almost impossible to translate their designs into practical working drawings. Nor does their failure arise from their having attempted effects which are too elaborate, and beyond the capabilities of the fabric. On the contrary, trade designers constantly set themselves, and successfully work out, problems enormously more difficult than any which have been attempted by more highly gifted but inexperienced artists.

Now from all this it has resulted that in the matter of design carpet manufacturers have been very much left to their own resources, and have received very little help from the outside. Many attempts have been made by them to enlist the services of great decorative artists, but for the reasons I have given they have almost always ended in failure. Large sums of money have been spent with results discouraging alike to both manufacturers and designers. And if the former have not of late years sought the aid of those who are foremost in other branches of decoration, it has been largely because of their dearly bought experience.

In one or two instances a certain amount of success has been attained. The late Mr. Owen Jones originated a number of very fine carpets, but they were too much informed with the spirit of his favourite Mauresque style to be available for general use.

Dr. Dresser also thoroughly mastered the technique of Brussels carpets, and produced a number of designs which complied with all the

requirements of a floor covering, but their somewhat cast-iron character and their want of variety prevented their permanent success.

While the so-called Early English style was in vogue, it was very successfully adapted to carpets by Mr. H. W. Batley, who produced a number of designs, exceedingly dainty both in drawing and colour; and at the present time the technical difficulties are being boldly grappled with by Mr. Arthur Silver, whose designs for carpets are as practical as his conceptions are original.

With the notable exception of Mr. William Morris, I am not aware that any great leader in decorative art has ever given serious attention to carpets, and I do not think anyone will say that his success has been so conspicuous in this as in other directions. While I am a most ardent admirer of Mr. Morris in every way, and am second to no one in appreciation of the great work he has done, I venture to say that his designs for carpets are not above criticism. Some of those I have seen appear to me to be simply wall-paper designs laid on the floor. Of others I can say, not as a matter of opinion, but upon unimpeachable authority, that if an ordinary manufacturer had produced the same things he could not have sold them. Further, I think he has not by any means taken full advantage of the possibilities of colour offered by carpets, especially in the matter of gradation of tint.

I feel it to be a very ungracious task thus to find fault with the work of one of whom we are all proud, but I cannot avoid alluding to his productions, and in doing so I must say frankly what I think. I shall probably be severely handled for my presumption, but I hope those who may condemn me will address themselves to the reasons I have given for the faith (or rather the scepticism) that is in me, rather than to my audacity in uttering them.

And while most of the leading designers thus turn away from carpets, manufacturers have much to complain of in their treatment by the writers who undertake to guide public opinion in matters of art. It is not so much that their efforts are subjected to searching criticism, which would be gladly welcomed, as that they are more or less completely ignored. Manufacturers of carpets are little known, and have little honour in their own country. They have few opportunities of making known their views, and are obliged to endure in silence the few perfunctory or supercilious phrases with which their productions are dismissed when critics deign to allude to them, or cannot avoid

doing so. In descriptions of beautiful houses the carpets are barely mentioned, and when shown at exhibitions they receive very scanty notices. And such as they do receive often reveal so much ignorance as to make one feel that in having to spin out paragraphs on a subject of which he knows nothing, it is the critic who is on his trial, and not the manufacturer.

It is not very long since a paper was read before this Society on "Design in Textiles," in which carpets were never once mentioned. This may have arisen from the inadvertent use of a too comprehensive title, rather than from any intention to ignore them, but it is a sign of the neglect of which I complain.

It seems to be generally assumed by critics that manufacturers are the natural enemies of artists, that they are wholly possessed by the commercial spirit, that to them design is nothing but a commodity to be bought as they buy their other materials, and in which they have no interest except in so far as they can turn it into money.

Now, while this may be true of some, there are others on whom it is a cruel libel, who strongly desire to do good artistic work, who have a real enthusiasm for their craft, whose ambition it is to see it take its rightful place among the decorative arts, and who have done much work which only needs to be known to be appreciated, even when judged by the highest standard. But it is generally done for its own sake. It is rarely profitable, and as it can only reach the cultivated public through the dealers, the manufacturer has not even the satisfaction of receiving credit for what he has done. He is in this position: Let him make what effort he may to attain a higher level in design, he finds himself checked and thwarted. Only one standard, the commercial, is applied to his work and only one set of influences is brought to bear upon him. The retail dealers are his judges, and practically dictate what shall be made.

Now I most gladly and thankfully recognise that among the dealers there are many who have the artistic temperament, and who are most anxious to co-operate with the manufacturer in encouraging the production of the best work. Some of them are so happily situated that they can give free scope to their inclinations, as they cater solely for a cultured *clientèle*. Others are obliged to repress their natural bias, and regretfully to pass by good things which they personally admire, but which experience tells them they cannot sell.

But these two classes are in the minority. The dealers, as a rule, simply gauge the taste of their average customer, and buy what will suit him or her. They are frankly commercial, and do not dream of applying any other standard; and from their point of view no one can blame them. Now, as carpet manufacturers do not advertise or take any means of appealing directly to the public, they are very largely in the hands of this latter class of dealers, and the result is shown in the character of many of their productions.

The method by which carpet designs reach, or fail to reach the public has an important influence. The result of a manufacturer's whole year's work is shown to a dealer, very often on a foggy winter morning, and the verdict then pronounced is final. If all the buyers decide that a certain pattern is not "safe," its fate is sealed, and unless an occasional inquiry be made for something of the kind it drops into oblivion. It may be said that painters have to undergo a somewhat similar ordeal when they send their work to the Academy, but they, at least, are judged by a purely artistic tribunal, and their acceptance or rejection is decided, let us hope, solely upon artistic grounds.

Wall-paper manufacturers have a much better chance of appealing to what is best in public taste, from the fact of their papers being shown in pattern-books. The public has a chance of seeing everything that is produced, while in carpets they see, as a rule, only what the dealer has bought; and I do not in the least blame the dealer for this. Anyone in his position would find himself driven by force of circumstances to do exactly the same. It is much easier to cater for the average man than for the half-educated, but wholly pretentious, amateur, who sometimes makes the dealer's life seem not worth living.

Another difficulty is, that it is impossible to get a higher price for one design than for another; good and bad, elaborate and simple, are all lumped together, if the fabric in which they are made be of the same quality. This would be of little consequence if better work commanded a large sale, but it is just the contrary, and a manufacturer who produces designs artistically inferior, but at a lower price, will get the preference. All this is very discouraging to the manufacturers who are anxious to produce a better class of designs. They are looked upon as wholly sunk in commercialism, and are placed in unfavourable contrast with manufacturers of other wares,

who avail themselves of the assistance of leading decorative artists. Now no one can be more conscious than carpet manufacturers themselves of the disadvantage at which they are placed through the want of any artistic influence from the outside upon their productions.

I am sure it never occurs to those whose susceptibilities are hurt by the specimens of carpets they see in the shop windows, that the manufacturer has, in many cases, fully shared their feeling of disgust, and bitterly regrets that circumstances compel him to produce such things. But what is he to do? He finds that to a very great extent he is obliged to keep his personal taste to himself. He is as fully conscious as the keenest of his critics that many of his productions violate every canon of good taste, and that the artistic labour expended on them is altogether mis-applied. He would not dream of admitting them into his own house, and continually feels called upon to apologise for them to the friends who expect better things of him. But those who have the public ear give him no help or encouragement, and he has to choose between trying to realise his own ideals, with the result of certain loss, and of ruin if he persists; or, on the other hand, yielding to the necessity of producing what will sell. I feel sure that if those who desire to see a high standard of art manufacture in this country were to realise this state of matters, they would make some effort to meet manufacturers half-way, and help them in their difficulties.

But to give this help it is necessary to realise the conditions under which manufacturers work. Of these the main point is, that to produce at a moderate price, large quantities must be made of each design, and of each separate colouring. Here we are at once met with the objection to mechanical repetition. But I fail to see why this should tell against carpets while it is accepted as natural and inevitable in wall-papers and other fabrics. If the condition of the repetition of the same form be kept in mind by the designer from the first, it is just as easy to do good work under this limitation as if unfettered variety were permitted. Nay, more, repetition is calculated to give that evenness of distribution, that balance and repose, which are in most cases so desirable in a carpet. And where variety and absence of repetition are wanted they can easily be had. Many rugs are made in which, though at first sight the same figure is repeated all over, it will, on close examination, be found to vary; and carpets can easily be made on

the same plan if purchasers are willing to pay for them. It is entirely a question of cost.

Another of the manufacturer's difficulties is caused by the host of so-called art advisers who have lately sprung up. Some few are competent artists, with whom it is a pleasure to co-operate, and who are strong enough, and magnanimous enough, to give the manufacturer full credit for his share in the work. But the weaker sort, who largely predominate, have generally for their sole qualification a certain glib facility in talking about art, and their assumption of knowledge is in inverse proportion to their possession of it. Their main idea is to justify their intervention by finding fault with whatever a dealer may happen to have in stock. If they were to approve what they find ready to their hand, they fear that their clients would begin to ask, "What are they good for?" and their occupation would be gone. But so long as they are dissatisfied with what they find, the client feels indebted to them from having saved him from he knows not what artistic blunder, and their reputation is safe. And apart from those who distrust themselves, and rely upon these advisers, there is a host of faddists who want their own ideas carried out simply because they are their own. They have a smattering of art knowledge, and a profound conviction that all dealers and manufacturers are necessarily quite devoid of it. If they were willing to pay for the embodiment of their crude notions it would not so much matter, but they expect to have them carried out at ordinary commercial prices, and in some cases they calmly propose that their valuable artistic suggestions should be considered in the price as an equivalent for so much material and labour. When people of this class buy Eastern carpets they are obliged to take what they can get, but the unfortunate British manufacturer is supposed to be unable of himself to produce anything good enough for them. They have not sufficient culture to recognise that he is very often a past master in a subject in which they are mere tyros.

The consumers who might naturally be expected to buy the better sort of designs are largely made up of these two classes. Consequently the dealer finds there is little use in keeping such designs in stock, and prefers to order in small quantities from hand to mouth, which is very unprofitable for the manufacturer, who accordingly is much tempted to avoid producing such designs altogether. The truth is that there is not a sufficiently large public to buy

good work in English carpets. There would be, if all persons of cultivated taste were to seek out the best productions of British looms instead of buying Eastern fabrics. But here commercial considerations stand in the way, and, for reasons satisfactory to themselves, many dealers prefer to further the sale of Eastern goods. Thus British carpet manufacturers do not receive so large a share of recognition for what good work they produce, as makers of other fabrics.

One of the charges most commonly brought against us is that we originate nothing good, that our best efforts are only feeble copies of Oriental or other ancient fabrics. Now, while this is partially (and it is only partially) true, I contend that even so far as it is true it is unfair. A test is applied to us to which other designers are not expected to conform. Take the art which is said to be the basis of all others. Are architects expected to design their buildings absolutely without reference to anything that has gone before? How do they train themselves for their work? Do they not study the great examples which have survived from the past, saturate themselves with their spirit, and fill their sketch-books with their details; and when they are called upon to design a modern building, do they not simply draw upon the store of material thus laid up, and evolve something suited to the special requirements of the case, but which, in all its main decorative features, is simply a reproduction of what they have assimilated, with something of their own superadded, the amount and quality of which is the measure of their originality. And in all this, is not the architect of the present day simply following in the footsteps of his great predecessors? Did the men of the 14th century start from first principles regardless of what had been done in the 13th? Do we admire their work the less because we can almost trace the current of the thoughts of those who evolved it? Do we sneer at them as imitators and copyists? Could they have done such mighty works if they had refused to profit by the past, and had attempted to evolve cathedrals out of their moral consciousness? To ask these questions is to answer them, and at the same time to answer a great many of the criticisms which are directed against us.

For to compare great things with small, the cases of architecture and of carpets run on all fours. In each there was a great period when the art was living and progressive, and during which great typical examples were evolved,

specimens of which still survive, and which are the despair of modern imitators. In each there was a period at which growth was arrested, and in each there has been a revival founded on the past, and in the midst of which we are more or less blindly groping our way towards the formation of what, centuries hence, will probably be recognised as a distinctive style.

The great 16th century carpets are, in their way, unapproachable masterpieces, just as the mediæval cathedrals are, and in taking them as our exemplars we are in distinguished company. I must admit that, in one respect the parallel is not complete, and that the architects have the advantage of us. Fortunately for them, buildings are not portable. If they were, and if one may judge from analogy, this country would be as full of Eastern mosques as it now is of Eastern carpets.

There is a strong tendency at the present time to condemn all attempts to evolve ornament on the basis of what has been already done, and to exalt those who are attempting to originate decoration by going direct to nature and conventionalising her forms by methods of their own. I have very great sympathy with their aims, which at one time I fully shared. I remember at that period I looked upon a Louis XVI. scroll as something positively immoral. It would be difficult to withhold one's hearty admiration from the men who are endeavouring to realise such ideals were it not for the feeling which will obtrude itself, that there is a certain amount of insincerity and affectation in their attitude. Those I have in view seem to say to themselves, "drawing is not our strong point, we find complicated arrangements troublesome, let us therefore devise a method in which drawing is of little importance, and let us create for ourselves a style, involving a minimum of labour, which shall be founded on nature as seen through our temperament," and they succeed; but there is one element of their temperament which they cannot eliminate, and which is fatal to their success. They are always self-conscious, and seem to say "Go to, let us be *naïve* and quaint." They are trying to do of set purpose what the great original workers in decorative art did without thinking much about it. These did not stop to analyse their conceptions and to say "I must reject this or that, however good it may be, because it is founded on what has been done before." In the modern work a certain *naïveté*, which is one of the greatest charms of all good original conventional ornament is wanting;

and it must be so, from the nature of the case. But when in place of this *naïveté* we find an affectation of it, resulting in the production of what one of its practitioners, with commendable frankness, speaking of his own work, calls "crude symbols," we must be pardoned if we cannot quite accept the one as the equivalent of the other.

I cannot too strongly protest against the assumption by this school that what they cannot do ought not to be done. They insist, for instance, on structure showing prominently, and on the necessity for emphasising the repeat. Now it is much easier to make a design showing its framework than one which conceals it. Subtlety means difficulty, and the taking of infinite pains. If a designer finds that he cannot achieve it, well and good. It is very commendable for a man to recognise his own limitations, and to accept them as the bounds of his own efforts; but when he attempts to lay down the same rule for others, and to make his incapacity the measure of their endeavours, one can only think of the tailless fox, and marvel how history repeats itself.

I do not, by any means, mean to argue that good designs cannot be made in which repetition is insisted upon. What I protest against is the laying down of any rules of this kind whatsoever. The only rules which should be observed are those which naturally assert themselves; those which arise out of the nature of the fabric, and the purpose to which it is applied.

These men are, unknowingly, setting themselves no less a task than the opposing of a great stream of tendency, of pitting themselves against that law of evolution which governs the operations of the human mind as well as of organic nature, and controls even that wayward thing, the artistic temperament, of which apparently it might be said, that like the wind, it "bloweth where it listeth."

Nothing is, apparently, farther from their thoughts than that the great generalisations of natural science have anything to do with them. But they would, notwithstanding, find it a useful discipline to give a little time to the study of its general principles. They would learn that we are all of us, decorative artists included, the creatures of heredity, modified to a slight extent by our present environment. Evolution has turned us out bipeds, and our wisest course is to make the best use of our legs instead of trying to grow a pair of wings.

As in nature, so in art, no great achievement has been arrived at *per saltum*. There may be apparent exceptions, like the sports familiar to gardeners, as when a plant, which has always borne white flowers suddenly produces a yellow one. But even here there is only a slight modification of what has gone before. And in art, as in nature, everything good and lasting has been founded on the past.

It seems to me that good decorative art must consist of two elements, the sum of the influence of what has been done in the past, plus the new element due to the idiosyncrasy of the artist. The first without the second is dead, the second without the first has life, but it is life striving to release itself from the guiding laws of evolution and heredity, and in the fruitless struggle it only produces abortions and monstrous growths. Suppose that in the organic world these great governing laws should cease to operate, what sort of animal and vegetable organism would be produced? And the same holds good in the world of mind.

I may seem to contradict myself in maintaining, on the one hand, that we are creatures of the past, and on the other, that we have power to impress our own idiosyncrasy on our work, but both are true. To borrow an analogy from our physical structure; we have inherited an apparatus admirably suited for walking purposes, but we can deform it by tight boots; and so with our mental equipment. We can either work with Nature along the lines we discover by observation of her methods, or we can, to a certain extent, thwart and impede her, with the certain result of crippling our bodies and stunting our minds, or, in some cases, it may be of causing unhealthy abnormal growths.

It is fortunate for designers of this type that their measure of executive power is frequently supplemented by a considerable development of the gift of literary expression. And in addition to their self-advertising solo performances, they are able to command a sympathetic chorus of admiration from their admirers among art critics, so, altogether, the voice of their trumpets is exceeding loud, and the not too discerning host of the Philistines is much impressed thereby. In such work as theirs there is more of the worker's delight in himself than in his work. The object seems not to be so much to produce a thing of beauty as to cause people to say, "What a very original artist."

It seems to me that this school, when they and their work have receded into the past, will occupy much the same position in relation to art that the Euphuists of the 17th century have in literature. Both movements alike will be seen to have their roots in self-consciousness and affectation, and will take their proper place as mere excrescences on the main stem of progress. Or to take an illustration from recent literature, some of the work that is done by the extreme men bears about the same relation to good decoration that Lewis Carroll's *Jabberwock* does to good literature. In both you have invention, originality, freedom from convention, and from the debasing influence of style. Both also appeal to our sense of humour, though in the case of the designers this is quite unintentional, and we are asked to accept their *Jabberwocks* as serious works of art. When a designer of this type comes in contact with a manufacturer, his soul is moved to indignation if, with the best and most kindly intentions, he is shown specimens of good work as an indication of the line he might usefully follow; and, here, by good work I do not mean mere commercial successes, but reproductions or adaptations of old fabrics, which are admitted on all hands to be good, and whose only fault is that they are not new. As, for instance, a manufacturer finds in some old brocade or velvet, forms which, when suitably arranged, make a carpet satisfactory in all respects, except that it is not original. He is reproached with this, and admits the justice of the reproach, inasmuch as he would prefer to produce something entirely new, of which he and the designer might share the credit. But any attempt to indicate what is wanted is resented by the designer as an unwarrantable cramping and fettering of his powers. It seems to me, on the other hand, that the reception of such a suggestion in such a spirit indicates an amount of arrogance and self-sufficiency, which would be tolerable only if it were found in conjunction with a complete mastery of the subject, and with executive powers of the highest order. If a modern designer can show that in any of his productions he has in any degree, in form and colour, approached the standard set up in the best work of the past, he might reasonably expect a mere manufacturer to give him a free hand, and to accept, with reverent gratitude, what he may be pleased to produce. But until he has so made good his claims, he can scarcely be surprised if his crude symbols are not accepted at his own valuation; nor

must he expect the manufacturer to acquiesce in the calm assumption that he is a mere master weaver, bound to defer to the designer's amateurish notions of what a carpet should be, for amateurism is writ large over all the productions of the extreme men of this school.

We do not want dictation, and I have given, and shall give, some reasons why we should not be expected to submit to it. Some of us have devoted many years to the study of the subject, and have brought to bear upon it such small measure of artistic training as we have been able to acquire. Can it be expected that we shall meekly accept the crude notions of the dilettanti dabblers who conceive themselves qualified to teach us? Their pretensions remind us of Triplet in Charles Reade's "Peg Woffington":—"Triplet was teaching the butcher's son how to plant onions. He had never seen onions planted, but he was one of those people who are always ready to teach anything to anybody." The assumption that the designer who has made no special study of the requirements of a particular fabric, should have a free hand whenever he chooses to turn his attention to it, is so ridiculous that it need only be stated to expose its absurdity. It is as though a sculptor should expect a commission for a picture without having shown the slightest capacity for dealing with colour. But we find the doctrine that architecture is the foundation of all the arts has taken such hold of some of its practitioners, that they consider themselves qualified to make designs, not only for houses, but for all things that are therein—an assumption which, in the case of carpets, has scarcely been justified by results.

It may be thought that I am going out of my way to attack this new English school of designers. I have said that I sympathise with their aims. I share their desire to escape from the bondage of tradition, and to create something which is their very own. But I think that, like other reformers in the past, in rebelling against authority they have gone to the other extreme, and are therefore certain to defeat their own ends. I should like to see their enthusiasm for art, and their undoubted inventive genius directed into channels where they could do work of permanent value. And I deeply regret that my own special craft must suffer from the lack of their co-operation, which would otherwise be gladly sought, so long as they maintain their present uncompromising attitude. I am convinced that their theories and their practice are fatal to the advance which I desire to see. Through their close

relations with a certain section of the Press they exercise an influence which I think a harmful one, and I fear that the glamour thus thrown round them and their works may result in the production of a host of feeble imitators, a result which I am sure they will agree with me is too awful to contemplate.

On one occasion the late Sir Philip Owen undertook to tell me how manufacturers should avail themselves of the advantages offered by the training schools and museum at South Kensington. He said, "You should take one of the young men who has passed through the schools with distinction, pay him a good salary, leave him entirely free and unfettered, let him remain here drawing inspiration from the wealth of material here accumulated, and take what he gives you. In this way only will you get freshness and originality."

Now this, which may I suppose be taken as the official view of the relations which should subsist between South Kensington and manufacturers, differs from that of what I have called the new English school, inasmuch as the latter eschews the idea of profiting by the work of the past, but they are at one in proposing to give the manufacturer no voice in the matter. I did not act upon the advice for several reasons. First, experience tells me that it is utter waste of time for anyone who has not had a thorough technical training to do work which shall be practically useful, and a manufacturer cannot be expected to pay for failures due to this cause, though, as a matter of fact, commissions are not unfrequently given to promising young designers, the results of which are paid for and then put in the fire. Then if it be a question of imbibing inspiration from the great works of the past, a manufacturer is much more likely to get good results from a designer who has been trained in his own methods, and knows exactly how to select and adapt to practical purposes, than from a young beginner, however gifted he may be.

I cannot withhold my conviction that so far as carpets are concerned, our art-training schools are not sufficiently in touch with manufacturers, to their mutual disadvantage. And, I think, this may to some extent arise from the frame of mind to which I have referred. Manufacturers are not invited in any way to cooperate, their advice is not sought. That their ideas upon the artistic side of designing should be ignored is not so much to be wondered at, but why their help has not been sought in technical matters is inexplicable. The result is seen in the carpet designs

at the annual exhibition of students' work. I have carefully examined these from time to time, and found that not one of those shown last year was free from technical faults, most of them so radical as to make the designs quite useless.

In support of this view, let me give a further quotation from the *Fortnightly* article. "South Kensington training, so far as it goes, is excellent, but the designer wants further instruction, more practical, technical, up to date. She also wants to be put into communication with the manufacturer, and through the criticism of able working designers to learn the technical requirements of the market; in fact, having been shown the theories of her *Art*, she wants to master her *Craft*." This is the students' view of the matter, and from my experience in dealing with young designers, I can heartily endorse it. The Women's School of Applied Art projected by Mrs. Dunlap-Hopkins, under the auspices of H.R.H. the Princess Christian, should do much to supply the want, and I have no doubt it will soon be followed up by a similar institution for men. I shall later on offer a suggestion as to a method of utilising the South Kensington Museum as a means of technical instruction.

It is, I suppose, conceded on all hands, that while there yet remains much to be done, there has been a very great measure of improvement in the design, and notably in the colouring of carpets, within the last twenty years. And what has been done has been almost entirely the work of manufacturers, and of the designers in their employment, who have been trained and guided by them. And here let me say that the manufacturer is not marked off by any hard-and-fast line from the designer. Occasionally the two are united in one person, and it frequently happens that the manufacturer is his own colourist. If he have any natural gift for colour, which I suppose will be admitted as possible even by those who look upon him as a mere master-mechanic, it can scarcely fail to be aroused and cultivated by the atmosphere of colour in which he lives and moves. In many cases, without putting pencil or brush to paper, he can, and does, impart to a design all that it has of distinctive merit.

Designers and writers on design steadily ignore the fact that in a carpet form is only a secondary matter as compared with colour. This is partly because graceful forms can only be approximately expressed, and in coarse fabrics can merely be suggested, and partly because in actual use the drawing is always

seen distorted by foreshortening, and broken up by furniture.

To illustrate the point that colour is more important than design, I may say that not unfrequently an effect of colour is decided upon before there is any thought of a design to carry it, simply by picking up tufts of coloured yarn, as one might gather flowers, and arranging them into combinations, subject to a certain dominant scheme. When this is done, a design is drawn with the sole object of displaying these effects. In fact, design is only a scaffolding for the construction of the real edifice. I am disposed to say that in many cases form is of no more importance in a carpet than in a sunset.

It is pretty obvious that writers on decorative art ignore colour because they are not themselves colourists. As I have elsewhere said, it might almost seem as if they lived in a monochromatic world, so insensible do they seem to be to the existence of colour. Now for this they are not wholly to blame, and so long as they have the modesty to recognise their own limitations, one must not be too hard upon them. The fault lies in the entire want of any provision for the systematic teaching of colour as a branch of ornament, of equal and, in some cases, of greater importance than what is commonly called design.

It seems to be thought that while drawing and composition must be carefully and systematically taught, colour may be left to take care of itself; that the colourist is born, not made; and that, therefore, there is no use in trying to train him. The student, as he grows up, finds that, judging by the examples set before him, form is all-important; and when, by-and-bye, he develops into a decorative artist, or an art critic, it is not to be wondered at that colour occupies a very secondary place in his thoughts.

In my opinion, colour requires to be taught with even greater care than design, and for this reason, that the colour sense develops later than the feeling for form. There are good reasons, we are told, for believing that this is true of the race as well of individuals, and that the Greeks of Homer's time had no true sense of colour, but only of light and shadow. Be this as it may, it is a matter of common observation that the power of drawing is usually acquired long before there is any indication of a mastery over colour. In the case of painters who have been great colourists, their early work shows no indication of any such gift.

At South Kensington there has until lately been little indication that the training of the public or of art students in colour has been present to the minds of those responsible for the collection and exhibition of that vast mass of material. The recent arrangement of the tapestries in a large well-lighted hall is a step in the right direction, but the bulk of the valuable collection of textiles is still in a dark gallery, where it is very difficult to see them. There is in the adjoining Natural History Museum a collection of minerals, many of which are so exquisite in colour that they seem to have been collected and exhibited as much for their beauty as for their scientific value. Whatever may have been the motive, there is little to compare with them for suggestiveness in the Art Museum. There colour appears, so to speak, incidentally. If an object selected for its form or its rarity has also fine colour, well and good, but there is little indication that anything has been selected for its colour alone. But the thanks of all who are interested in art applied to textiles are due to Professor Middleton for what he has done, and has been so undeservedly attacked for doing. I hope he will persevere in the course he has adopted. In the museum of a country where weaving is one of the great industries, textiles should have a more prominent place than they have hitherto occupied.

This leads me to ask, why should we not have a colour school and a colour museum. When one thinks of what such a collection might be if selected and arranged with this sole end in view, the prospect, to anyone with a keen colour sense, may almost be called intoxicating. It need not be costly on the whole. Why should not some of the lovely effects now produced in various materials be made the basis of such a collection. One continually sees in shop windows, in all sorts of fabrics, passages of colour that would be well worth preserving. Fashion may at any time decree a return to magenta and emerald green, and the formation of such a collection as I advocate could not fail to have an effect in averting such a consummation, if fine pieces of colour, instead of being a memory of the past, were to be kept permanently before our eyes. Such a collection could not fail to have an effect, not only upon decorative art, but upon the rising school of painters. It need not be confined to manufactured articles only. Beautiful bits of natural colour, when these are capable of being preserved, might be added,

such as the minerals I have referred to, with birds, insects, shells, lichens, and so on.

It may be said that all these can be found by those who have eyes to see them, but one does not follow this principle in other branches of education. If such objects were brought together, and arranged with descriptive labels analysing the scheme of colour in each case, and showing, by means of an example placed alongside, how such a scheme might be applied either to a picture or to a piece of decorative art, the educational value would be enormous. It is probably for the want of some such training that in the revival of the feeling for good colour, which is so marked a feature of the last twenty years, a greater number of artists have not turned to carpets. For in colour possibilities, carpets of certain makes stand at the head of all textiles. There is no other woven fabric in which the number of colours is unlimited in theory and so large in practice. It is wonderful that the scope thus given does not prove a greater attraction to those artists who are naturally stronger in colour than in design. It might be thought that in looking round for a medium in which to express themselves they would have eagerly seized upon carpets.

Such a scheme as I suggest might, if carried out, be not without influence on other arts, music for instance, in a way not at first sight apparent. We know that Richard Wagner was unable to give form to some of his great tone conceptions until he had arrayed his person in gorgeous colours. And so a sensitive composer straying into such a chromatic paradise as I have conceived, might receive inspiration which might bring forth a great symphony. And the converse holds good, for in one's own experience music is sometimes found very stimulating, and suggestive of decorative conceptions. A successful design has been originated on the back of a concert programme. But lest I may be crediting music with more than its due share of such influence, it is only fair to say that a long dull sermon has been known to produce a similar result.

I have said that great advances have been made in the colouring of carpets. The improvement has been mainly along two lines. First, tints more beautiful in themselves, and more suitable for their purpose, have been used, and secondly, elaborate gradation has been adopted where flat tints were once used. At one time, in making reproductions of Eastern carpets, their variety of tint was

looked upon as a defect. But it has long since been recognised that perfect evenness of colour is not desirable. A great advance has been made by using gradation of colour in flat designs. In my opinion, one of the reasons why many people prefer representations of raised ornament in a carpet is because of the delicate gradation of tints which is necessary to express it. I am surprised that this has not been pointed out by writers on decorative art, and that no credit has been given to those who have solved the problem of retaining all the charm of gradation, and of combining this with perfect flatness of treatment, avoiding on the one hand any imitation of relief, and, on the other, the bald uninteresting effect of flat ungraduated colour.

Here let me say a word in my own defence against a possible charge of inconsistency. I have elsewhere held up French designers as worthy of imitation in their methods of representing light and shade in carpet designs; but, in recommending young designers to study these methods if they wished to produce designs of a similar type, I was merely pointing out the shortest way to practical commercial success. I carefully guarded myself against expressing any approval of such designs, and made it sufficiently clear that, personally, I heartily disliked and condemned them. I imagine that the chief difference between myself and my critics lies in this, that I know there is, and is likely to be for some time to come, a considerable demand for such designs, and I am not prepared to advise young designers to neglect them. Their doing so would not lessen the demand, which would be supplied somehow, and the only result would be that they would find it more difficult to earn their bread and butter. The improvement in taste which—in England, at all events—we may hope to see brought about, must be effected by other means, such, for instance, as those I am now endeavouring to suggest. But the foreign and colonial trade will remain, and in some of these markets we cannot expect to see a high standard of design adopted for a long time to come, if ever. Will it be argued that English designers are entirely to neglect the only methods which will enable them successfully to cater for such markets? I am not prepared to say so.

Returning to the question of the improvement that has taken place in colour, I claim that carpet manufacturers have made great advances, which have received very scanty recognition. It would really seem that some

of the critics must be colour-blind, or must go about with their eyes shut. Not long ago I saw the crude colouring of the foliage in a picture condemned as "carpet greens." The critic was simply repeating a phrase he had heard in his youth, without noticing that it has for many years ceased to have any relevancy.

I cannot refrain from alluding to a curious instance of a similar frame of mind which came under my notice in Australia. I heard it said, in playing a game of cards, that "the deal goes round the same way as the sun." I pointed out to the players that this was true in England, but not south of the Equator, where the sun apparently goes the other way. They had never noticed this. The oddest thing is that they were young men, who had never been out of Australia. Their fathers had carried the phrase with them from the old country, and the sons mechanically adopted it. This is a perfect parallel to the mental state of certain critics who keep on repeating stock phrases and ideas which were once more or less correct, without taking the trouble to notice things as they are.

The samples before you are shown mainly for the purpose of illustrating the great advances that have been made, and over a period of 50 years, commencing with a sample of the first design ever made in Patent Axminster. This is a portion of a carpet which has been in actual use for more than half a century.

The improvement that has been made has been largely derived from the careful, and let me add, the discriminating study of the best Eastern examples. And here I must say that a great deal of nonsense is talked about the way in which the charming gradations and variety of colour in Eastern carpets are produced. I have been solemnly informed by a high authority that the streaked effect of a plain ground Indian carpet was the result of consummate artistic feeling on the part of the weavers, who occupied a position in their country as important as that of our Royal Academicians. All the while it was perfectly obvious that the irregularity arose from imperfect dyeing, or from imperfect matching through dyeing in small quantities. No doubt this sort of talk has its commercial value, and secures fancy prices for very commonplace objects.

In the case of some beautifully coloured antique carpets, the colour is even at the back and shaded on the surface, showing that the

effect is due to unequal fading. It is very amusing to see how imperfections of all kinds are accepted in Eastern fabrics. I once asked a clever salesman how he managed to sell rugs which were irregular in shape, or which would not lie flat. He said:—"We tell them that's where the individuality comes in." I once tried the experiment of making deliberate mistakes, such as weaving two-thirds of a rug on red ground, and the rest on black, and found that they were sold without any difficulty. Unintentional blunders of a similar kind have also passed muster. We owe something to our Eastern rivals for having educated the British public up to this point.

There is no doubt that many of those who would otherwise bring their influence to bear upon the designing of British carpets are prevented from doing so by the feeling that they need not take the trouble, as there is an inexhaustible supply of satisfactory fabrics from the East. Now I have no wish to make an appeal *ad misericordiam*, or to raise the cry "support British industries." Commercially, we are quite able to take care of ourselves, and if we are not, we must go to the wall. But we do ask for some sympathy and assistance in our efforts to raise the standards of design in our productions. I may so far appeal to national sentiment as to say that I am sure everyone interested in art would be glad to see English carpets take a much higher place artistically than they at present occupy. And all I ask is that such persons should take some little interest in the subject; should seek out the best that English manufacturers are capable of doing before passing them by, and should recognise that such manufacturers are anxious to meet them more than half way. I think, too, they should recognise that they are fostering in the East exactly what they deprecate at home—the slavish copying of traditional designs. I fail to see why a copy of an ancient Persian carpet should be right if made in an Indian gaol, and wrong if woven in an English factory; and in the East, bent as they are on making exact reproductions, they are unable to do so except in the matter of form, for the colours of modern Eastern carpets are often simply atrocious, and the dyers seem utterly unable even to appreciate the merit of the colouring of the splendid old examples which are set before them, much less to reproduce it. Horrible magenta pinks, crude yellows, and emerald greens are accepted as a matter of course, if they come from the East, in preference to really fine pieces of colour in British fabrics.

So much is the superiority of English colouring recognised, that it is not uncommon for English versions of Eastern designs, which have been faithfully coloured after ancient examples, to be sent out to India and Persia as guides for colouring. Here I think I see the supercilious smile of the superior person, and hear him say, "Thus does commercialism ruin Eastern art." Now I hold no brief for the importers who do this thing. Their interests and ours as manufacturers are opposed. Nevertheless, I speak of what I know, when I say that their action is a proof that the colour sense which is so keenly alive at home has to be artificially fostered in the East. The reason English carpets have been sent out is because they are much nearer in colour to the great classical examples than are most of the crude and garish productions which are turned out by the present generation of Eastern weavers when left to themselves. I am by no means certain that the sending out of these samples of good English colour has any result. But the fact that they are sent shows that they are needed, and is an indication of the superiority of English colour to that produced unaided by Orientals.

In spite of the fact that slavish copying of a limited number of traditional forms is the rule in the East, it is continually assumed that all Oriental work is unfettered, spontaneous, full of individuality, while British carpets are mechanical and uninteresting. I have heard carpets condemned in these respects as being machine-made, every stitch of which had been wrought by hand. So much for the power of imagination in certain critics.

Those who might bring an elevating influence to bear upon the designing of English carpets should realise that, in passing them by and encouraging the use of Eastern fabrics, they are simply giving full sway to the commercialism they so much and so justly detest, and are handing manufacturers over to its uncounteracted influence. And if they are designers they are spoiling their own market, for in proportion as they, by precept or example, encourage the use of Eastern carpets, they decrease the demand for designs of the highest class. Suppose that by any means the supply from the East were suddenly to fail, can there be a doubt that, in spite of all its difficulties, the best decorative artists would be driven to turn their attention to carpet designing, and would find in it a new and a profitable market; and a designer might, by arrangement with two manufacturers be able

to use the same idea twice over, first, say, for a curtain, and afterwards modified to make it suitable for a carpet, to the great benefit of the designer and also of the public, who would find the problem of finding wall and floor coverings to harmonise, greatly simplified.

The necessity under which manufacturers labour, of producing, year by year, a quite unnecessarily large number of designs, is one reason why their quality is not higher. It is becoming more and more unusual for a pattern to last for more than a year or two. How is it possible, under such a system, for designs to be evolved equal to those of the East, which undoubtedly were the slow growth of considerable periods of time, which passed from weaver to weaver, receiving various modifications by the way, and of which many versions, good and bad, must have been produced, the best being most highly prized, and therefore surviving to our time.

Here, again, writers on art might do good service by advocating the retention of the good as distinguished from what is merely new, and the South Kensington authorities might give valuable help by making collections of good contemporary work. I shall refer to this later.

When British carpets are compared with those from the East, this continual demand for novelty should be borne in mind. If an entirely fresh set of patterns were demanded from, and produced by, Eastern weavers year by year, what sort of designs should we get? I do not advocate that British manufacturers should settle down to a mechanical reproduction of the same forms, or slight variations of them, but if they were not compelled to produce so many new things, the quality of those produced could not fail to be improved.

The necessity laid upon manufacturers of studying the requirements of foreign markets is not sufficiently kept in mind by their critics. And in this respect manufacturers find themselves between the devil and the deep sea. They are often blamed in consular reports for not studying the taste of foreign customers, and so losing their trade; but when they do study it, and produce designs exactly suited to it, art critics blame them for turning out such horrors.

The only remedy I can see for this state of things is the creation of so great a demand at home for the best class of designs that the manufacturers who desire to produce them will find a sufficiently large consumption to warrant

their devoting themselves entirely to such work.

It should not be overlooked that even in those markets where taste is at its worst there has been a vast improvement in recent years. In the South American market, while the class of designs asked for remains much the same as formerly, there has been an enormous advance in the appreciation of good colour. In Australia, the fern-tree gully and waterfall style of design is a thing of the past, and there is also a growing sense of the merit of fine colour. In the United States there is a comparatively small cultivated public which can appreciate the very best work, but the general demand of late years has been for designs of extraordinary lightness and delicacy. Nothing more absolutely wrong in a floor covering could possibly be devised.

I cannot refrain from putting on record a protest against the shameless systematic piracy from which carpet manufacturers have suffered for many years at the hands of their American competitors. The world has been kept well informed of the grievances of authors and publishers, but we have had to suffer in silence. The British public has no idea of the extent to which this has been carried. Large factories in the United States have been kept going, and fortunes made, almost entirely by stolen designs. The American manufacturer has absolutely no sense of shame in this respect. Their emissaries come over here, and buy our goods for the express and avowed purpose of having them copied. The same persons, who are strictly honest, so far as material objects are concerned, who would not on any account steal a roll of carpet, have no scruple in conveying to their own use a design which may have cost ten times as much. No doubt there is now a copyright law, which, in theory, offers some protection, but, in practice it is, for various reasons, of little or no value, and the piracy of carpet designs goes on as merrily as ever.

I must admit that some English manufacturers have retaliated in kind, but they have very little opportunity of doing so, as few American designs are suitable for the home market. In some few instances honourable arrangements for the exchange of designs have been made.

We suffer considerably also from piracy by German and French manufacturers, with the additional aggravation that while we are almost shut out by heavy tariffs, they come here and under-sell us with copies of our own designs. Registration is of little value as a

protection, and for this reason—it only takes account of form. Now, as I have said, the merit of a design may be entirely owing to its treatment and colour, and it is easy to apply these to forms which look quite different in a photograph or black and white drawing, but which in the actual fabric come so near the original as to pass for the same thing.

Returning to the main point—the means by which manufacturers may be assisted in their efforts to produce a higher class of design—I venture to make a suggestion to the authorities at South Kensington. One way in which great encouragement could be given would be the collection, at the museum or elsewhere, of examples of the best modern instances of applied art. I cannot understand why this is not more largely done. It was at one time commenced in the case of furniture, to a very small extent. The expense in the case of textiles would be next to nothing. Year by year beautiful stuffs are being produced, and year by year they drop into oblivion. If such a collection be not formed now, it may be that 100 years hence the museum authorities will buy at a fancy price a collection of imperfect fragments of the very stuffs which they could now acquire for a merely nominal sum. Possibly there may be some rule or resolution against the acquisition of contemporary work, and it may be alleged that it would lead to jobbery and favouritism. But I think any risk of this kind might be run, in the face of the manifold advantages of the plan. Here again an idea might be borrowed from the Natural History Museum, where the very full descriptive labels form a complete text-book in themselves, so that he who runs may read. The samples of fabrics might have similar labels, pointing out their artistic merits, and also giving, for the benefit of students, full technical details of the method by which the design is produced, together with samples showing the different stages of manufacture. Thus the double purpose would be served of bringing good work before the public, and of educating art students in technical details. I would lay great stress upon the educational value of such illustrative examples. A set of them, with full printed explanations, would give the student all the technical information he needs much more quickly and effectually than he could acquire it from books, and would in many cases save him from a great deal of wasted labour. I will undertake to convey to any intelligent student the whole art and mystery of carpet

designing solely by means of a set of such examples and the descriptive letter-press attached, without a word of verbal explanation.

I think that at the same time the South Kensington authorities might usefully revive an institution which existed there about twenty-five years ago. At the entrance there were two cases, filled with objects selected from the Exhibition of 1851, which were pilloried as examples of bad or misapplied design. The same idea, expanded into a chamber of horrors, might serve a useful purpose. I don't know whether it might be feared that manufacturers whose productions were thus gibbeted might be disposed to consider the proceeding libellous, but I can only say that my own firm would not object to see some of their carpets so treated, if we were allowed at the same time to state why we produce them, and to exhibit samples of what we should like to produce instead.

To sum up, if I am asked to say definitely what I really want, it is this:—That men of light and leading should take the trouble to look carefully into the subject. If they find I am wrong in my opinion that much good artistic work has been done, and that the *Fortnightly* writer is right in her sweeping statement, "The English manufacturer has not yet succeeded in decorating his production with artistic, and therefore suitable patterns," let them say so. But let them at the same time point out in detail where we have failed, and indicate, also in detail, the course we should pursue. We ask not only for opinions, but reasons for them, and I think I have shown cause for my demand that we should not be dismissed with mere *obiter dicta*. We have had enough of the slipshod-offhand style of criticism, and I believe we are largely indebted to it for the estimation in which we are held by the faddist amateur, and the art adviser. If the only result of my appeal should be to increase their numbers, our last state would be worse than the first.

In conclusion, let me say I am quite prepared to hear that I am wrong in many of my views, and that there are aspects of the subject which I have overlooked. I shall be very glad to be corrected; but whether I am right or wrong, my purpose will have been served if I have succeeded in drawing attention to the subject, and in placing it clearly before the minds of artists and critics from the manufacturers' point of view.

If you should think that on any point I have expressed myself too warmly, I ask you to

remember that those for whom I speak have for years felt that they had grievances which they have been obliged to bear in silence, and a strong sense of injustice may have added some keenness to the Bitter Cry of the Outcast Manufacturer.

DISCUSSION.

The CHAIRMAN said Mr. Millar, in this paper had adduced various reasons for the present state of things, and made several suggestions of value. Amongst the reasons were (1) The unwillingness of decorative artists to learn the technical requirements of carpet designing; (2) the ignorance and indifference of critics; (3) commercialism and the resulting timidity of dealers; (4) the want of originality; (5) the cheapness of oriental carpets; (6) the desire for quaintness which had been pandered to by certain designers; and (7) he criticised the impractical designs which had been premiated at South Kensington at the national competitions. Now South Kensington was a pillar which any one might throw a stone at, but it was often forgotten that it included three divisions or branches, though they were often lumped together, viz., the examining or prize awarding department of science and art; the museum, with its splendid collections; and the school, which was primarily for the training of art masters, but also for the training of any one who chose to pay the fees. All of these were under the department; but it was as well, in speaking of South Kensington, to distinguish which branch was alluded to. He would only say further on this point, that official judges of the competitions were appointed, and that only the designs premiated were exhibited, so that the exhibition was not a complete statement of what had been submitted. Complaint was justly made of the demand for new patterns annually; in fact carpets came under the same curse of fashion as almost everything else, and this was a thing very much to be regretted. But in this as, in regard to ladies' dress, the reply was always, you might as well be out of the world as out of the fashion. He, himself, had suffered from the piracy of the Americans; the first series of Cantor lectures which he gave in that room were reprinted in America, and the illustrations processed, and, not only that, but they misspelt many of his words, so that it was like "adding insult to injury." The suggestion of a Colour Museum was most valuable. It was his custom, when at the sea-side, to carry a geologist's hammer, and to split open the boulders one found lying about, and some of them were wonderfully suggestive in colour. He often found them useful to his students at South Kensington in giving suggestions of colour, which, otherwise, would never have been dreamed of. Such a colour museum, however,

should be arranged from the artistic point of view, not the scientific; it should deal with pigments, not with colours, as the man of science understood them. The idea of labelling was also very good, and it was carried out splendidly in the Natural History Museum, so admirably organized by Sir William Flower, who once said that a museum should be not a collection of objects with explanatory labels, but a collection of labels with explanatory objects. Another suggestion of the author was to have a gallery of horrors; there used to be something of the sort where things were hung up as samples of bad work, but he was afraid if it were reintroduced he certainly should not like to have the selection of it, or the task of writing the labels. The paper finished with an appeal to intellectual Englishmen to take an interest in this question, which was to some extent, perhaps, answered by the large and discriminating audience which had assembled, amongst whom, no doubt, there were many who would be prepared to take part in the discussion.

Mr. GLEESON WHITE said he was hardly competent to deal with the subject, not being a carpet designer. Mr. Millar had somewhat emphasized the line between a manufacturer's design and an artist's design, and pointed out that an artist could never understand the manufacturer; perhaps some manufacturers on the other hand could never understand the artist. With that he had been a little hard on those whom he said sought for designs which were quaint, and who strove for novelty at any cost. He thought these designs never passed the boundary of the factory, at any rate he had not seen them in the shop windows. Carpet designs were not signed, and therefore there was a difficulty in knowing whether it was the artist who had failed, or the manufacturer who had succeeded. The suggestion of forming a collection of the things which were being produced now, for the benefit of posterity, made one think of the library of the British Museum, and he wondered whether manufacturers would like to be compelled to send a yard or two of everything they produced to a certain number of museums in the same way as publishers were required to send books, and whether the Government would like to have to provide space for such an accumulation. One difficulty about writing or speaking of colour was that there was no positive terminology of colour as there was of form: one person's green might be another person's blue, for anything you knew.

Mr. LEWIS DAY confessed to a little disappointment at not having heard anything about carpet designing, which he wanted to learn about; he had only heard the "bitter cry of the manufacturer." Mr. Millar's complaints touched him personally, first as a designer, secondly, as having dabbled more or less in criticism, and thirdly, as having been one of the wicked judges at South Kensington; and he might

therefore say a word or two on the other side. He did not quite agree with the author that the designer resented the conditions under which he had to design. If he was really a designer, he thought those conditions rather stimulated him. The reason why designers did not take to carpet designing was partly that it was more difficult and required more knowledge of technique than some other things, and partly, perhaps, because so much depended on colour, and he understood that the manufacturer had that in his own hands. If the manufacturer were a colourist he might make beautiful things out of designs which were insufficient, but he might also spoil a good design, and an artist did not greatly crave to work in a medium, over the final stage of which he had no control. No doubt the good manufacturer came in for some of the abuse which the bad one deserved, and he shifted the blame on to the retailer. Mr. Millar said the dealer "gauged the public taste," but in that he could not agree. He forced his own taste on to the market, and the public could only buy what the dealer provided; many beautiful things were stillborn simply because the dealer did not like them. The dealer or salesman managed to sell what he liked, and what he did not like he declared would not sell. The pattern book was a great source of complaint to the wall-paper manufacturer, instead of an advantage, because the best things showed to great disadvantage in a pattern book, and the consequence was that the worst things were bought, and, when used, were condemned. Some years ago, in criticising English art generally, he alluded slightly to carpets, and expressed the opinion that the good designs then current were mainly, if not entirely, borrowed from the East, and he was inclined to think so still, notwithstanding the very beautiful things shown to-night. The best carpets on the walls were emphatically those which were most distinctly Eastern. He might make, perhaps, one exception, that taken from a Coptic tapestry, which showed greater originality than any of the others. He did not quite know who Mr. Millar was girding at, for he did not know of any class of artists who advanced precisely the opinions attacked by the reader of the paper. He did not think anyone contended that people should always be struggling for something absolutely new, or that they should not be influenced by what had gone before. Such a thing was impossible; a man often did what he thought original, and then found it was very like something he had seen before, just as a well-turned phrase which came to him as an inspiration often turned out to be a quotation. At the same time, when a thing was too obviously traceable to its source that was rather against it. He did not know that anyone had sneered at the attempt to introduce Persian forms; designers of carpets could not do better than start with a study of the Persian, but it did not follow that they should go no farther. Nor did he think anyone nowadays insisted on showing the repeat in a pattern. He

had himself insisted on designers basing their pattern on a geometrical construction, but it did not follow that that construction should be obtrusive to the eye. Mr. Morris had said no doubt that it was pleasant to see a frank recognition of the lines on which a thing was designed, but that was only an individual opinion. When a manufacturer bought a design and did not produce it, it was not always the fault of the artist. He had known cases where such designs were left for years, until that particular kind of thing began to be known, and then, when it was too late, they were brought out. There was great want of pluck on the part of manufacturers. It was suggested that a school of design should be established on the plan of Mrs. Dunlop Hopkins. It would be time, he thought, for the Americans to come and teach us how to design when they had done something themselves better than we were doing already. That was not yet the case. We had a teaching institution at South Kensington. It was not his business to defend that much-maligned school, but if it was not doing what it was established to do, it would be better that it should be stirred up to do it, than that a rival school should be set up. With regard to piracy, the Americans were not the only pirates. He had said that he had not designed carpets, but he had seen his wall papers reproduced in carpets, very much to his annoyance. If the British manufacturer were in earnest in desiring honesty in trade, he would insist on having a copyright law which would protect designs of every kind. He had enjoyed the paper very much, and hoped that in criticising it he had not exceeded the limits which the author prescribed for himself.

Mr. J. ALDAM HEATON, as a student of design, and, to some extent, a designer, wished to say a word on a point which seemed to have been overlooked, viz., the evolution of design. This was an extraordinarily slow business, slower than many people recognised. They expected design to grow up like a mushroom, in a night; if they found a clever designer they expected him to produce something absolutely novel and original which should astonish everyone. But if it had taken 2,000 years to evolve Westminster Abbey from a Greek temple, how could the evolution of design be so rapid. It was one of the slowest things mankind did. In Etruscan pottery, you constantly came on little diapers, more or less like the Greek key, and the same thing was found all over the world. He had lately discovered it coming from the Andes on the spindles of hand-spinning machines, which unquestionably dated back to the time of the Incas. Why had all these countries produced their little diapers, which were remarkably similar to each other? It was impossible to suppose that Greece or Egypt had inoculated the country of the Incas. The explanation was, that in a certain initial stage of progress, when men had a little leisure, they began to decorate the stems of their lances and the handles of their knives,

and so on; and the whole history of design had to be thought of as a continuous stream coming down from those early beginnings. Its growth was exceedingly slow, that of an oak was quite rapid in comparison. It did not go on at an equal pace; now it was too fast, now too slow, and at times false steps were made, as in the time of the Georges; but, sooner or later, mankind sifted the good from the bad, and the evolution went on the whole steadily forward. Novelty was only obtained by the fresh use of old forms, and therefore it was absurd to attack a carpet manufacturer for using old forms; he could not do anything else. Design in carpets had grown more through Persia and the East than any other countries, and it was therefore neither possible nor desirable for the manufacturer to rid himself of Eastern designs. It was preposterous for a few young ladies and gentlemen to think that, by forming an Arts and Crafts Institute, they were going to show the world how to evolve in a new way. He did not deny the existence of great talent in some of these people, but no single individual, nor yet a score, could make any great change in the evolution of design in any direction. Even Michael Angelo himself was only one in a long series extending over thousands of years.

Mr. H. T. GEORGE said he spoke with some diffidence of South Kensington, because he was supposed to have received his art education there, but as far as he could recollect when he went there, there was no one who knew anything about the designs of carpets. He told his masters what he wanted to study for, and they immediately advised him to pass into the antique. He must confess that he soon got at loggerheads with the masters, but he knew what he was studying for, and they did not. He thought if at South Kensington, as at Kidderminster, they had some one who understood the practical designing of carpets, it would not be the bye-word it was in some quarters to-day.

Mr. CHARLES HINDLEY said he had been surprised to hear from Mr. Day that the dealer or his salesman could sell what he liked; he only wished he could; he could show beautiful things, but he could not sell them in many cases; the public wanted educating in these matters. Manufacturers, however, did pander to some extent to the commercialism of the day; a man who could buy largely, whether he liked good patterns or bad, or whether he did not know what he did like, had a great advantage over the man who was really an artist in his own line, and knew a good carpet from a bad one. Everyone wanted things cheap, and no one set a good example by encouraging manufacturers to produce the best articles they could. When the finest antique carpets were produced in Persia, things were very different. He saw a glorious carpet the other day, which he was told represented the work of eight men for five years. Taking the

wages of eight weavers, at the present day, for five years, that would represent something like £10,000. No doubt the carpet was produced under a despotic government, and if the men had refused to work they might have lost their heads, but at any rate they were kept in some amount of comfort while working. If for instance money was found for a grand carpet for the entrance hall of the Imperial Institute, and Mr. Millar, or some of his colleagues were employed to spend that amount on one carpet, he ventured to say they would produce something which would equal even the old examples which were so much admired.

Miss WEBSTER said the Turkey carpets—so called—to be seen in many houses were, some of them, very ugly, and the colours very crude; and some of the imitation Eastern carpets on the walls were very depressing; she should not like to spend many hours alone in a room carpeted with them. The Kidderminster carpets of the present day were not equal to those of the beginning of the century; they were much coarser, and the colours and design were crude in the extreme. After referring in detail to several of the specimens exhibited, she said the idea with many people at present was to make the floor look miserable and monotonous; but in London, at any rate, one wanted something a little bright and cheerful.

Mr. G. P. BAKER said he admired very much the way in which Mr. Millar had taken up this subject. No doubt a knowledge of technique was necessary in a designer in any branch, but especially so perhaps in the case of carpets. South Kensington, so far as London was concerned, should be the centre for that knowledge, and he should like to see Mr. Millar one of the judges or council at South Kensington in connection with this branch of industry. He, for one, admired the quaint designs, and though they did not go, he believed something better would be evolved from them. He should like to know why the specimen under the clock was exhibited.

The CHAIRMAN having proposed a vote of thanks to Mr. Millar, which was carried unanimously,

Mr. MILLAR, in reply, regretted that time did not allow of his dealing at length with some of the points raised. He was obliged to the Chairman for calling attention to the three divisions of South Kensington, and must confess that of one of them, the examining body, he had forgotten the separate existence, though he had thought of the other two. He could not agree that the scientific men should be left out of the scheme of a colour museum; the scientific side of colour was as necessary as the artistic, and there was no reason why the

two should not go together. He knew there was a feeling of antagonism to the science of colour on the part of many artists, he shared it himself once, and shut up a book and put it aside for ten years from that feeling; but on looking into it again he found the two views could be reconciled. One dealt with coloured lights, and the other with pigments, but the facts of nature could not contradict one another, the facts the artist found in pigments and those which the scientific man found in differently coloured lights could not be contradictory. The colourist had to be armed at all points. Blue and yellow paints mixed made green; but blue and yellow lights mixed, did not, and those two facts had to be reconciled. Mr. White objected to the idea of a colour museum because there was no positive colour terminology, but that was not necessary. He proposed to have specimens of beautiful colour in natural objects and, beside them, samples of how these effects could be produced in a manufactured article, so as to form an object lesson. Mr. Day complained that he had not said anything about carpet designing, which was true, but the fact was he started the paper on too large a scale, and had to leave part of it out. He had intended to give some demonstration of the *technique* of carpet designing, and hoped to be able to do so at some future time. He had frequently found designers turn away from carpets because they did not like the conditions. Mr. Day said the manufacturer had the colour in his own hands, but that was an abnegation on the part of the designer of a large part of his work.

Mr. DAY said he understood Mr. Millar to claim that for the manufacturer.

Mr. MILLAR said his statement was that the manufacturer was often a colourist, but when he bought a design he wanted to buy the colour as well as the form. Great advances had been made in colour of late years, but that had been the work of manufacturers, and not of outside designers. He had not intended any special reference to Mr. Day in the paper, but he did remember that gentleman reviewing the work of the Victorian era, and saying something about carpets, but he did not say one word about colour in connection with them. His remark about the pattern books showed the advantage of looking at things from both sides. As to borrowing designs from the East, he had tried to show that they were in the midst of a system of evolution. They had only recently begun to recognise the merits of Eastern carpets; thirty years ago they were only recognised by a few, and manufacturers had only begun the study of this matter. He must refer again to what he had said about architecture; they were doing exactly what the architects were doing with buildings, but they had not had anything like so long to do it. The only way to evolve anything good out of an old style was to begin by faithfully studying and, at first, copying that style. The

reason why some designs, though purchased after being commissioned, were not produced was not because they were either good or bad, but because they were impossible, from ignorance of technique, as when sixteen frames of colour were introduced in a Brussels carpet, no human being could make it. He must object strongly to what Mr. Day said against Americans coming here to teach us design. We ought to welcome useful suggestions from any quarter. If there were no technical school of design here, and if an American lady had succeeded in establishing one in America, and came over here—no matter what her motives might be—and did the same, we should not allow any international prejudices to stand in its way. If there was a great want to which she was the first to call attention, her work should not be ignored because she was an American. He did not quite follow what Mr. Hindley said about large buyers and small ones, and if he would read the paper at his leisure he thought he would find that he had done full justice to those dealers who were anxious to co-operate with manufacturers in doing the best work. With reference to Kidderminster carpets, there had been an extraordinary improvement in them, which was entirely due to Mr. Wm. Morris. The rug which Mr. Baker had inquired about was brought to illustrate the point that eastern work was not necessarily good. By a certain class of writers everything eastern was supposed to be good in colour, but while he should be the last to say that the best English work was equal to the best eastern he did say that the best English was a great deal better than much that came to this country from the east now, and that was why he brought that particular specimen.

Mr. ARTHUR SILVER writes:—Although I can thoroughly sympathise with Mr. Millar, and lament with him for the apparent scanty encouragement which is offered to the most important of our textile industries, yet, looking at the matter from a designer's point of view, I am inclined to consider that one reason is owing to the fact that designing for carpets presents more obstacles than designing for other fabrics. In the first place, he must master the technical difficulties, and possess a sufficient knowledge of working on the ruled paper. Assuming that the difficulties have been overcome, and he has accustomed himself to the work at a very considerable expenditure of time, he will find that his experience, bought at the expense of ignoring other work, is available for carpets only; whilst experience gained in designing for one printed fabric qualifies for innumerable other fabrics. Another obstacle is owing to the numerous varieties of cloths. Many manufacturers have their own special gauges, and though the character of the design may suit one manufacturer, he may not employ the gauge upon which the design is worked; this involves a serious risk to the designer.

To be an expert with the ruled paper is an exclusive business, and so keen is the competition, that many manufacturers who insist on adhering to a "trade" custom of buying designs by the yard, would be aghast with an outsider who required the equivalent of remuneration according to the time involved. Therefore, taking into consideration the obstacles to be surmounted, the tedium of the mechanical process, the keenness of competition, and the time involved in obtaining a knowledge of the various makes, and of the firms who employ them, I am bound to state that designing for carpets presents a maximum of risk for a minimum of profit, even though the "outsider" may present designs which some manufacturers will acknowledge to be entitled to payment considerably in advance of the market rates. If, therefore, the outsider, who has more or less experience in the branch, finds the means of livelihood barely forthcoming, I cannot see how those who occupy the greatest prominence in decorative design can reconcile themselves to the making of experiments to produce a practical drawing, when other work, which under the circumstances would involve more interest to them, must remain in abeyance. I must not omit to state that some manufacturers welcome small-scale freehand drawings, which have afterwards to be translated to the ruled paper; this certainly overcomes some objections, but the method cannot be successfully indulged in until some experience on the ruled paper is first obtained, otherwise their work is liable to be non-practical. But designs in this form are only welcomed by a very few; some cannot mentally realise the actual result, and others object to the double outlay involved in transferring it to the ruled paper. Mr. Millar refers kindly to my work; it is only fair to state that such merit as it is entitled to is mainly due to his exceptional powers of lucid exposition of the technical points. As one keenly interested in this matter, I am grateful to the Society of Arts for having brought this subject forward, and to Mr. Millar for dealing with it. Before concluding, I should like to emphasise the extreme value of the suggestion made respecting a school or museum of colour for industrial work. I trust this will be further agitated; I may mention that during the course of a year I have applications from many hundreds of students and "designers;" about 1 per cent. will exhibit a skill in design beyond the average, but not 1 in 500 can show an original, harmonious, and practical colour scheme. This should speak for itself.

Miscellaneous.

CASK-BORING BEETLE.

A boring beetle (*Xyleborus perforans*, Wall) which has occasioned great damage to beer casks in India, is the subject of Mr. W. F. Blandford's report to the

Secretary of State for India (1893, pp. 48, with plate and figs. in text). The structure of the beetle is shown to be similar to that of *X. affinis* (or Kraatzi), a sugar-cane boring beetle (described by Miss Ormerod, 1892), the habit of the two varieties being only modified by their food and the consistency of the material in which they burrow; they are therefore considered together. It is probable that *X. perforans* has been conveyed to India in commercial intercourse, that it is not indigenous, but of tropical American or Antillean origin. Now acclimatised in India, although its distribution is irregular and its appearance sporadic, it has proved itself to be the most destructive of all boring beetles. It is unknown in England or in any European zone. The insect is minute, the calibre of its burrow being No. 5 on a Eichhoff's gauge. The transverse section of a boring insect determines the calibre of its burrow and is an important indication of its species.

The first recorded appearance of the beetle in India was in 1850. Official inquiry ensued, and the report under notice is a commentary on subsequent correspondence. The full extent of its ravages is unknown, but in 1861, at Calcutta, out of 16,500 hogsheads in store, 8,000 had suffered, 6,000 of porter and 2,000 of ale; and again, in 1879, 1,131 hogsheads of ale, and 677 of porter in store were injured. At other places varying per-centages of casks were attacked. Sometimes the beer was still good, although wastage had occurred; but a cask badly burrowed was leaky and useless. Formerly beer casks were ill-cared for on arrival in India, and they remained in store for long periods (nine or ten months, and eighteen months to two years often elapsed between unshipment and use of the contents). The import trade of beer in cask has now shrunk. Indian breweries have been established to meet the local demand, and the manager of one of these says that in the last fifteen years, using imported casks of the Government pattern, the borer has given him no trouble; but he takes care that casks shall return within a month or six weeks from the date of delivery to customers, and if they are detained two months complaint is made. Beer in cask should not be exposed to the sun, or placed with other merchandise likely to attract or harbour the beetle. Stores should be solidly built, with impervious floors, kept scrupulously clean and dry. The casks subjected to frequent examination, should, if infected, be steamed or soured in boiling water and then dried. At the cooperage sound material can be substituted for defective parts. Applications of paint, tar, alum, quassia, &c., are discussed. Common points of attack are at a crack, or any depression of the surface where moisture collects, and particularly near the bung and the ends of staves at their junction with the head. The apparent holes on the exterior are very much more numerous than punctures of the interior skin. The burrow is made by the perfect female: in it she deposits her eggs; it is always void of wood powder, and of uniform calibre throughout its ramifications.

The primary gallery is usually stained black, off-shoots are repeated irregularly at abrupt angles, and there are tie passages. Near the inner surface the lateral galleries spread, and a very thin layer of wood interposes, through which the ooze of liquor keeps the burrow moist. The larvæ do not bore, and are nourished by fungoid growths. The male is, numerically, by far the rarer sex. Males are much smaller than females, and they cannot fly, their wings being rudimentary. Females, on emergence from the burrows, fly freely, and are commonly attracted by lights. The period elapsing between oviposition and the maturity of the insect may probably be six weeks. The reporter says there is still no complete collection of Indian wood-boring beetles available for reference, nor have they been systematically studied on the spot. There are several varieties, and some are noticed in the paper. When the outbreaks occurred, the Government of India referred the evidence to experts in England, whose opinions are cited.

THE CULTIVATION OF VANILLA IN TAHITI.

The cultivation of vanilla has been carried on in the Island of Tahiti for several years, but is limited to a few districts only, that of Papara supplying more than half of the quantity sent into the market. Consul Hawes, of Tahiti, says that the native method of culture is, as a rule, simply to plant the cuttings of the vine under the shade of trees, and then to leave them to grow and twine round supports as best they can. Occasionally attention is paid to keep the vines trained round the tress, and to prevent them from attaining a greater height than nine feet, so that during the inoculating season the flowers may be reached without difficulty. Shade is absolutely necessary during the growth of the vanilla vine to ensure a successful crop of beans. About one year from the time of planting the vine commences to flower, and the inoculation which then takes place must be carefully attended to; this is generally carried out by women and children, whose light hands are best suited for this delicate operation. In from six to nine months from the time of inoculation the bean will be ripe for picking and curing. The native method of curing is to keep the beans alternately indoors rolled in cloth and out of doors during the day spread on mats exposed to the sun for periods of three or four days at a time until they are dried and ready for the market. The disadvantage of drying on mats in the open, of having beans frequently wetted and deteriorated in value by sudden showers before there is time to get them under cover, has made itself apparent to many native planters, who now dry their vanilla in boxes with glass covers. They are usually filled three-quarters full, the beans being placed on a blanket in the bottom of each box, and covered with a double thickness of blanket at the

top. The glass lids are then put on, and the boxes exposed to the sun for about fifteen days, when the beans are generally found to be sufficiently sweated to admit of their removal to the drying house. This building is constructed throughout of corrugated iron, and contains three tiers of wire shelves. The beans are laid on the top tier first, then they are moved to the second and third in succession as they gradually dry, and remain on the latter until they are perfectly dry and fit for the market. Consul Hawes says that Tahiti vanilla is inferior to that of Mexico, Bourbon, and Mauritius, and this drawback is not improved by the careless manner in which the natives and even Europeans dry and tie the bundles of beans for export. The export trade in this article has increased considerably during the last ten years, the United States being the principal market, although small quantities are sent from time to time to France and England. The total quantity of vanilla exported in 1883 from Tahiti amounted to 276 lbs.; in 1890 it amounted to 15,882 lbs., and this quantity increased in 1893 to 25,560 lbs., valued at £4,418.

Correspondence.

RAILWAYS IN INDIA.

When I was concerned, some fifty years ago, with Sir R. Macdonald Stephenson, Mr. Heath, Mr. John Chapman, and Sir W. P. Andrew, in the advocacy and establishment of railways in India, in which we met with great obstruction from the Government authorities, a Government could sufficiently discharge its duties to its subjects by making a provision of any kind of common roads. Since then the world has altered, and a partially civilised South American State must supply its people with an adequate provision of railways. The authorities ruling India have neglected this duty, and in some years have not spent a shilling or eight annas per head in providing railways. In the discussion at our Society and in other places, it has been discovered that financial difficulties stand in the way. As a matter of practical economics it is not easy to understand this. Poorer communities have managed to find railways. As railways are reproductive directly and indirectly, some way is found of employing the credit of the community in providing funds. Practice, experience, and common sense are all in opposition to the Government neglect of railways, and in favour of their duty of providing them. With regard to the cost of bullock-power, my friend Mr. W. Martin Wood will find that distinguished engineer, the late Daniel Adamson, did not rate bullock-power too high at 6d. per ton per mile. If Mr. Wood will refer to my old papers and data on the cost of bullock-power in India, he will find costs of a rs., 1s. 6d., and 2s. per ton per mile at old prices. It is the same in other parts of the world as to animal-

power. Even water-power when properly calculated comes out very differently from what is imagined. A sufficient test can be found in a patent fact that the St. Lawrence, the Mississippi, and the Plate have no more prevented railways than the Nile, the Ganges, or the Nerbudda. Until adequate provision has been made for railways in India, the development of the countries and the welfare of the populations will be retarded. No man does good to India who resists the teachings of long and general experience, and of common sense.

HYDE CLARK.

LONDON COAL-GAS AND ITS ENRICHMENT.

Major DE WINTON writes :—Doubtless in common with many members of the Society of Arts, I have read with much interest Professor Lewes's paper on "London Coal-gas and its Enrichment," published in the *Journal* of April 13th. The ignorance of the householder is referred to, and surprise is felt at his non-use of "burners of rational construction" (p. 426), but nowhere are we told where to obtain "burners of rational construction," and their cost. If Professor Lewes would tell us this, he would confer a favour upon many of the members of the Society, and notably upon myself.

Obituary.

LIEUTENANT-COLONEL WILLIAM HAYWOOD, M.I.C.E., F.R.I.B.A.—Colonel Haywood, engineer of the City Commission of Sewers, who was elected a member of the Society of Arts in 1867, died on the 13th inst., at his residence in Hamilton-terrace, Maida-hill. He was born in 1821, and was appointed engineer to the Commission of Sewers in 1846, having previously occupied the office of assistant-engineer. In 1851 he, in conjunction with Mr. Frank Forster, prepared a scheme for diverting the sewage from the northern side of the Thames; and in 1854, with Sir Joseph Bazalgette, he extended the scheme, and it was eventually carried out by the Metropolitan Board of Works. He constructed more than half the sewerage of the City, and to him was mainly due the introduction of asphalt carriage-way pavements. From his plans more than one-third of all the public ways in the City have been widened and improved. In 1856 he designed and laid out the City of London Cemetery at Ilford. From 1863 to 1870 he constructed the Holborn Viaduct, which cost nearly four millions of money, and which was opened by her Majesty in person on November 6, 1869. In 1879 he laid down a complete system of fire hydrants for the City. In 1883 he designed and erected a crematorium for burning street refuse. Only a few weeks

ago he retired from his office in consequence of ill-health, but the Commission of Sewers invited him to continue as consulting engineer at his full salary. He joined the London Rifle Brigade in 1859, and became lieutenant-colonel in 1876, retiring in 1881. The Commissioners of Sewers exhibited at the Chicago Exhibition, and a medal has been awarded for "Models and drawings of works designed and carried out by Lieut.-Colonel William Haywood."

General Notes.

CHICAGO EXHIBITION BUILDINGS.—The buildings of the World's Fair at Chicago have been sold for \$75,500 (£15,100). The purchaser is a Mr. Garrett, of St. Louis, and he has undertaken to clear away the buildings by the 1st of May, 1896. The South-park Commissioners, to whom Jackson-park belongs, have therefore received for the use of the park a sum of \$200,000, which was paid to them by the Exposition Company, and the above mentioned \$75,500—\$275,500 (£55,100) in all. In addition to this, they have the advantage of the permanent improvements which have been made on the grounds.

IMPORTS OF HAY.—In continuation of the statistics of the imports of hay into the United Kingdom during the year 1893 (see *ante* p. 215), the *Board of Trade Journal* gives the following figures for the months of January and February of the present year:—North Russia, 13,382 tons, Denmark 1,060, Holland 3,085, Canada 2,012, United States 33,896, Chili 1,251, Argentine Republic 365. The amounts for the corresponding months were:—Denmark 270 tons, Holland 1,846, Canada 721, United States 10,393, Argentine Republic 3,320; the total for January and February, 1894, being 58,712 tons against 17,616 tons in the corresponding months of 1893.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock :—

APRIL 25. — "Some Recent Development of Photographic Chemistry." By CHAPMAN JONES, F.C.S.

MAY 2.—"Nickel." By A. G. CHARLETON, A.R.S.M. PROF. W. C. ROBERTS-AUSTEN, C.B., F.R.S., will preside.

MAY 9.—"Telegraphs and Trade Routes in Persia." By COLONEL WELLS.

Papers for which dates have not yet been fixed :—

"Reproduction of Colour by Photography." By CAPTAIN W. DE W. ABNEY, C.B., F.R.S.

"Automatic Gem and Gold Separator." By WILLIAM S. LOCKHART.

"Application of Electricity to the Disinfection of Sewage." By MONS. HERMITE.

"Liquid Fuels." By G. STOCKPLETH.

FOREIGN AND COLONIAL SECTION.

At Eight o'clock :—

MAY 29.—"Education in Victoria." By Prof. C. H. PEARSON, M.A., LL.D.

INDIAN SECTION.

THURSDAY, APRIL 26, at 4.30 p.m.—"Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh." By SIR AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., late Lieutenant-Governor of the North-West Provinces and Oudh. SIR STEUART BAYLEY, K.C.S.I., C.I.E., will preside.

APPLIED ART SECTION.

Tuesday Evenings, at Eight o'clock :—

MAY 8.—"Pewter." By J. STARKIE GARDNER. PROF. W. C. ROBERTS-AUSTEN, C.B., F.R.S., will preside.

MAY 22.—"Decorative Art in connection with Elementary Education." By SELWYN IMAGE, M.A.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock :—

HENRY CHARLES JENKINS, A.M.Inst.C.E. "Typewriting Machines." Two Lectures.

April 30; May 7.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 23. Camera Club (at the HOUSE OF THE SOCIETY OF ARTS). Annual Conference, 3 to 6 p.m. and 8 to 10 p.m. Reading of papers and discussion.

Meteorological, Sanitary Institute, 74A, Margaret-street, W., 8½ p.m. Mr. G. J. Symons, "Instruments and Observations, and their Representations."

Scottish Society of Arts, 117, George-street, Edinburgh, 8 p.m. 1. Report on Mr. Magnus Finlayson's Paper, "An Improved Lantern Slide Carrier." 2. Report on Dr. Orphoot's Paper, "A Rubber Appliance for hermetically closing bottles." 3. Mr. R. G. Hislop, "An Automatic Safety Hoist Door." 4. Mr. Thos. Edmondson, "Direct Current Dynamos and Motors, their Magnetic and Electric Circuits, &c."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Prof. C. Lapworth, "The Face of the Earth."

British Architects, 9, Conduit-street, W., 8 p.m. Messrs. John Belcher, C. F. A. Voysey, Aldam Heaton, and W. D. Caröe, "Furniture: Domestic and Ecclesiastical."

TUESDAY, APRIL 24...Camera Club, at the HOUSE OF THE SOCIETY OF ARTS, 3 to 6 p.m. Conference continued. 8 p.m., Lantern Slide Exhibition.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. A. Fleming, "Electric Illuminations." Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Papers by (1) Mr. Leveson Francis Vernon Harcourt, on "The Training of Rivers;" and (2) Mr. Henri Léon Partiot, on "Estuaries."

Photographic, 50, Great Russell-street, W.C., 8 p.m.

WEDNESDAY, APRIL 25...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Chapman Jones, "Some Recent Developments in Photographic Chemistry."

Geological, Burlington-house, W., 8 p.m. 1. Mr. T. V. Holmes, "Further Notes on some Sections on the New Railway from Romford to Upminster, and on the Relations of the Thames Valley Beds to the Boulder Clay." 2. Dr. J. R. Leeson and Mr. G. B. Laffan, "The Geology of the Pleistocene Deposits in the Valley of the Thames at Twickenham, with Contributions to the Fauna and Flora of the Period." 3. Mr. Herbert Bolton, "A New Goniatite from the Lower Coal-Measures (*Goniatites elegans*)."

Royal Society of Literature, 20, Hanover-square, W., 8 p.m.

THURSDAY, APRIL 26...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Indian Section.) Sir Auckland Colvin, "Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh."

Royal, Burlington-house, W., 4½ p.m.

Meteorological, Sanitary Institute, 74A, Margaret-street, W., 8½ p.m. Dr. H. R. Mill, "Temperature of Air, Soil, and Water."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. F. Bridge, "Mozart as a Teacher" (with musical illustrations).

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Mr. R. E. Crompton, "The Cost of Electrical Energy."

Camera Club, Charing-cross-road, W.C., 8 p.m. Mr. Rowland Briant, "The Art of Topography."

FRIDAY, APRIL 27...United Service Institution, Whitehall-yard, 3 p.m. Colonel T. S. Cave, "The Training of Volunteer Officers."

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Prof. H. Marshall Ward, "The Action of Light on Bacteria and Fungi."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Science Schools, South Kensington, S.W., 5 p.m. 1. Dr. C. V. Barton, "The Mechanism of Electrical Conduction." 2. Major Hipperley, "A Graphic Method of Constructing the Curves of Current in Electromagnets and Transformers." 3. Professor S. P. Thompson, "The Design and Winding of Alternate Current Electromagnets."

SATURDAY, APRIL 28...Botanic, Inner Circle, Regent's-park, N.W., 3½ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Dr. H. D. Traill, "Literature and Journalism."

Supplement to the
JOURNAL OF THE SOCIETY OF ARTS.

FRIDAY, APRIL 20, 1894.

CHICAGO EXHIBITION, 1893.

LIST OF AWARDS FOR GREAT BRITAIN.

[The awards are all of equal value. This list includes awards for various exhibits not included in the British Section. The awards in the Women's Section are given under the various Groups, not in the single Group in the Department of Ethnology, &c., under which Women's Work was catalogued.]

DEPARTMENT A.—AGRICULTURE.

Group 1.—Cereals, Grasses, and Forage Plants.

R. and J. Garton, Newton-le-Willows—Wheat.
John Plunkett and Co., Dublin—Barley.
R. R. Hill and Sons, Drogheda—Oatmeal.
W. H. Mold, Bethersden, Ashford, Kent—Wheat.
John M'Cann, Drogheda—Oatmeal.
Keen, Robinson, and Belleville, London—Patent barley and groats.

Group 2.—Bread, Biscuits, Pastes, Starch, Gluten, &c.

R. Parkinson and Sons, Burnley—Baking-powder.

Group 3.—Sugars, Syrups, Confectionery, &c.

J. S. Fry and Sons, Bristol—Pure concentrated confectionery.

Crosse and Blackwell, Limited, London—Fruit Syrups.

British Bee-Keepers' Association, London—Honey.

Group 6.—Preserved Meats and Food Preparations.

Crosse and Blackwell, Limited, London—Preserved meats and fish.

Crosse and Blackwell, Limited, London—Preserved soups, vegetables, and table preparations.

Joseph Edmunds, London—Anchovies, curry paste, and pastes.

Frederick King and Co., Limited, London—Desiccated soups and vegetables.

Maconochie Bros., Lowestoft—Flavouring essences, preserved fish, and preserved meats.

Maconochie Bros., Lowestoft—Preserved soups, vegetables, table preparations, and plum pudding.

Jubal Webb, London—Hams.

The Liquor Carnis Company, Limited, London—Carnis preparations.

Bovril, Limited, London—Extract of beef.

Group 7.—The Dairy and Dairy Products.

Jubal Webb, London—Cheese.

Irish Industrial Association, Dublin—Village Dairy.

Group 8.—Tea, Coffee, Spices, Hops, and Aromatic and Vegetable Substances.

Crosse and Blackwell, Limited, London—Pickles, sauces, condiments; essence of coffee.

Keen, Robinson, and Belleville, London—Keen's mustard.

Thomas J. Lipton, London—Tea, coffee, and coffee essence.

T. and H. Smith and Co., Edinburgh—Coffee essence.

J. S. Fry and Sons, Bristol—Cocoa and chocolate.

Bovril, Limited, London—Bovril cocoa essence.

Birmingham Vinegar Brewery Company, Limited, Birmingham—Collective exhibit of Holbrook's Worcestershire sauce, pickles, olives, ketchup cayenne pepper, curry powder.

Maconochie Brothers, Lowestoft—Pickles, sauces, and condiments.

Joseph Edmunds, London—Curry powders and chutneys.

British Deli and Langkat Tobacco Company, Limited, London—Wrapping leaf tobacco.

Group 10.—Pure and Mineral Waters, Natural and Artificial.

W. A. Ross and Sons, Limited, Belfast—Raspberry vinegar, ginger ale, and royal soda water.

Reginaris, Limited, London—Reginaris water.

Belfast Mineral Water Co., Limited, Belfast—Seltzer and kali water and beverages.

William Corry and Co., Belfast—Lemonade, ginger ale.

T. and H. Smith and Co., Edinburgh—Champagne koka.

Group 11.—Whiskeys, Cider, Liqueurs, and Alcohol.
John Dewar and Sons, London—Highland whiskey.
Charles R. Haig, London—Welsh malt whiskey.
John Hopkins and Co., London—Scotch whiskey.
D. P. McDonald and Sons, Fort William, N.B.—Pure malt whiskey.

James Menzies, Glasgow—Blended whiskey.
The Old Bushmills Distillery Co., Limited, Belfast—Old Irish whiskey.

J. and W. Nicholson and Co., London—London gin.
R. Thorne and Sons, Limited, London—Scotch whiskey.

Crosse and Blackwell, Limited, London—Malt vinegar.

Alexander Riddle and Co., London—Lime juice cordial.

Evans, Sons and Co., Liverpool—Montserrat lime fruit juice.

Maconochie Brothers, Lowestoft—Lime juice cordial.

W. A. Ross and Sons, Limited, Belfast—Lime juice cordial.

L. Rose and Co., Leith—Lime juice cordial, raspberry vinegar.

Archibald Lauder, Glasgow—Whiskey.

Malcolm Brown and Co., Dundalk, Ireland—Irish whiskey.

Group 12.—Malt Liqueurs.

W. A. Ross and Brother, Liverpool—Hop bitter ale, Guinness's extra stout, and Bass's foreign export pale ale.

Burroughs, Wellcome and Co., London—Extract of malt.

Bingham-Cox and Co., St. Albans—Imperial stout in wood, strong ale in wood, India pale ale in wood.

M. B. Foster and Sons, Limited, London—Guinness's stout (bottled), Bass's pale ale (bottled).

M. O'Reilly and Co., Dublin, Ireland—Irish pale malt, patent roasted crystal malt, amber malt.

Robert Porter and Co., London—Bass's bottled pale ale, Guinness's extra stout.

Deasy and Co., Clonakilty, County Cork, Ireland—Bottled stout.

Samuel Allsopp and Sons, Limited, Burton-on-Trent—Bottled "Red Hand" ale, India pale ale, extra stouts, bottled "Red Hand" extra stout, Old English strong ale.

J. and R. Tennent, Glasgow, Scotland—Pilsener. Bock beer, pale ale, and stout.

Group 14.—Farms and Farm Buildings.

W. Burdett-Coutts, London—Farm model, &c.

J. McDowall and Co., Glasgow—Horse and cattle condiments.

Group 15.—Literature and Statistics of Agriculture.

Sir J. H. Gilbert, F.R.S., and Sir John Bennett Lawes, Bart., F.R.S., Harpenden, England—Results of experimental farm.

Group 17.—Miscellaneous Animal Products—Fertilizers and Fertilizing Compounds.

Anglo-Continental Guano Works, London—Fertilizers, Peruvian guano, and nitrate of soda.

Maconochie Brothers, Lowestoft—Calf's foot jelly.

The Drogheda Chemical Manure Co., Drogheda—Manufactured manures.

Group 18.—Fats, Oils, Soaps, Candles, &c.

Price's Patent Candle Co., Limited, London—Stearine, candles, paraffin, and glycerine.

Price's Patent Candle Co., Limited, London—Toilet soaps.

Ingham's Eucalyptus Oil Co., Rockhampton—Eucalyptus oil.

Quibell Bros., Newark-on-Trent—Disinfecting soap.

Clarke's Pyramid and Fairy Light Co., Limited, London—Candles.

Group 19.—Forestry, Forest Products.

Bombay-Burmah Trading Co., London—Timbers and planks of teak wood.

Alice M. Hart, London—Dye-stuff and dyeing.

Jane Williams, Aberffraw—Baskets made from grass.

DEPARTMENT B.—HORTICULTURE.

Group 21.—Pomology, Manufactured Products, Methods, and Appliances.

Crosse and Blackwell, Limited, London—Preserved fruits.

Batger and Co., London—Jams, jellies, and marmalades.

Group 22.—Floriculture.

H. Cannel and Son, Swanley—Collection of phloxes, collection of primroses, collection of peonies, collection of dahlias and cyclamens.

James Carter and Co., High Holborn, London—Collection of cyclamens, collection of primroses.

Anthony Waterer, Woking, Surrey—Collection of rhododendrons and azaleas.

F. Sander and Co., St. Albans—Ornamental foliage plant.

John Laing and Sons, Forest-hill, London—Primroses.

Kelway and Son, Langport, Ireland—Primroses.

Alex. Dickson and Sons, Newtownards, Ireland—Collection of roses.

Group 25.—Arboriculture.

Anthony Waterer, Woking, Surrey—Coniferous evergreen.

DEPARTMENT D.—FISH AND FISHERIES.

Group 38.—Sea Fishing and Angling.

Milward and Sons, Redditch—Fish hooks.

R. Turner and Sons, Redditch—Fish hooks.

The Baltimore School of Fishery, County Cork—Model of school.

James Buchanan, Glasgow—Fish hooks, &c.

Archibald J. Maclean, Pennycross—System of signals for fishing boats; plans for salmon fishery stations; designs for fishermen's dwellings.

Group 39.—Fresh-water Fishing and Angling.

- Mrs. Letitia Brocas, London—Flies for trout and salmon fishing.
 William Barbour and Sons, Limited, Lisburn—Salmon nets.
 Wm. Bartlett and Sons, Redditch—Fish hooks, flies, spoons, fish lines, floats, spears, and nets.
 Anderson, Anderson, and Anderson, London—Anglers' waterproof clothing; oil skins.
 Wm. Turnbull, Edinburgh, Scotland—Case of salmon flies
 R. Turner and Son—Artificial flies; bait-lines and floats.

Group 40.—Products of the Fisheries and their Manipulation.

- A. and J. Q. Corner, Wick, Scotland—Pickled and cured fish.
 Archibald J. Maclean, Pennycross—Model of fish box; model of refrigerating railway van; treatise on preserving ice.

DEPARTMENT E.—MINES AND MINING.

Group 42.—Minerals, Ores, Native Metals, Gems, and Crystals; Geological Specimens.

- Bennett H. Brough, London—Collection of economic minerals.
 J. E. Ball, D.Sc., London—Collection of economic metallurgy.

Group 43.—Mineral Combustibles—Coal, Coke, Petroleum, Natural Gas, &c.

- Cory Brothers and Co., Limited, Cardiff—Smokeless steam coal.
 W. and J. Turner, Wigan—Cannel coal "New Abram."
 North's Navigation Collieries (1889), Limited, Cardiff—Steam coal and coal coke.
 Crown Preserved Coal Co., Limited, Cardiff—Crown preserved fuel in blocks.

Group 44.—Building Stones, Marbles, Ornamental Stones, and Quarry Products.

- Farmer and Brindley, London—Egyptian porphyry; imperial Egyptian porphyries.
 John Dean and Co., Liverpool—Slate slabs, plain and enamelled.

Group 45.—Grinding, Abrading, and Polishing Substances.

- Beckmann and Co., London—Emery wheels, slabs, files, and hones.

Group 46.—Graphite and its Products; Clays and other Fictile Materials and their Direct Products; Asbestos, &c.

- Farnley Iron Co., Limited, Leeds—Fire clay, glazed bricks, porcelain baths.
 Lower Lonsdale China Clay Co., St. Austell, Cornwall—China clay.
 W. G. Nixey, London—Black lead, stove polish, and flour emery.
 British Fuller's Earth Co., Limited, Woburn Sands—Fuller's earth, crude and manufactured.

- J. R. Lloyd Price, Bala—Fuller's earth, granular and powdered.

- Fuller's Earth Union, Limited, London—Fuller's earth, crude and variously prepared.

- Albion Clay Co., Limited, Burton-on-Trent—Fire clay bricks, terra cotta, &c.

- Fuller's Earth Mining Co., Limited, Woburn Sands—Crude and prepared Fuller's earth.

Group 47.—Limestone, Cements, and Artificial Stone.

- Francis and Co., Limited, London—Cement and whitening work done in cement.

- East Anglian Cement Co., Shepreth—Cement (materials, products, and tests).

- Irish Portland Cement and Brick Co., Limited, Dublin—Portland cements and products.

- Francis and Co., Limited, London—Portland cement and products and testing machine.

- F. C. Barron and Co., London—Portland cement.

- Gibbs and Co., Limited, Essex—Thames Portland cement.

Group 48.—Salts, Sulphur, Fertilizers, Pigments, Mineral Waters, and Miscellaneous Useful Minerals and Compounds.

- The Salt Union, Liverpool and London—Collection of dairy, table, white, and rock salt.

Group 49.—Metallurgy of Iron and Steel, with the Products.

- The Low Moor Co., Limited, Bradford—Sections of coal and ironstone measures; pig-iron and finished iron.

- Wm. Jessop and Sons, Limited, Sheffield—Crucible cast steel in bars, sheets, and forgings, and steel castings.

- George Cradock and Co., Wakefield—Steel and iron wire ropes.

Group 54.—Metallurgy of Antimony and other Metals not Specifically Classed.

- Johnson, Matthey and Co., London—Platinum and platinum apparatus and rare metals.

Group 61.—Boring and Drilling Tools and Machinery, and Apparatus for breaking out Ore and Coal.

- James McCulloch, Wolverhampton—Rio Tinto rock drill; economic air compressor.

- Richard Hornsby and Sons, Limited, Grantham—Steam pneumatic rock drill.

- Bickford, Smith and Co., Limited, Tuckingmill, Cornwall—Safety fuses and ejectors.

Group 64.—Apparatus for Crushing and Pulverizing.

- W. H. Coward, Bath—Niagara crushing mill.

Group 66.—Assaying Apparatus and Fixtures.

- Morgan Crucible Co., London—Assay apparatus of clay goods.

- Thomas Clarkson, Sutton, Surrey—Sampling machine for treating either ores, grain or liquids.

DEPARTMENT F.—MACHINERY.

Group 69.—Motors and Apparatus for the Generation and Transmission of Power—Hydraulic and Pneumatic Apparatus.

Joseph Baker and Sons, London—Gas-engine, oil-engine.

Caddy and Co., Limited, Nottingham—Tubular chilled-face smoke-consuming fire bars, for boilers and other furnaces.

Economic Smokeless Fire Co., Bradford—Leggett and Marsh's patent smoke-consuming fuel economising appliance for steam-boilers and general cooking and heating purposes.

Galloways, Limited, Manchester—Engine.

Richard Hornsby and Sons, Limited, Grantham—Oil-engine.

David Joy, Westminster—Model of the Joy valve gears.

Macfarlane, Strang, and Co., Limited, Glasgow—Cast iron water-pipe, straightway or gate valves, water meters, water filters.

Noble, Brown, and Co., Leeds—Portable fire and garden engines, leg pumps, and portable bath.

Willans and Robinson, Limited, Thames Ditton, Surrey—Willans's compound central valve engine, and Siemens's dynamo combined.

J. Armytage Wade, Hull—Apparatus for raising stones and other substances without injury to pumps.

Group 70.—Fire-engines—Apparatus and Appliances for Extinguishing Fire.

Messer and Thorpe, London—Fire buckets and cases for storing the same.

Group 71.—Machine Tools and Machines for Working Metals.

B. and S. Massey, Manchester—Steam and power hammer.

Peter Wright and Sons, Dudley—Anvils.

Group 72.—Machinery for the Manufacture of Textile Fabrics and Clothing.

W. H. Grant and Co., Foleshill, Coventry—Jacquard silk-weaving loom.

Roberts, Royle, and Co., Manchester—Light power loom for making fancy coloured goods.

Platt Brothers and Co., Limited, Oldham—Exhibit of cotton cleaning, combing, and carding machinery.

Group 77.—Miscellaneous Hand-Tools, Machines, and Apparatus used in Various Arts.

Crees and Co., Limited, Devizes, Wiltshire—Dishwashing machine.

Davies Brothers and Co., Limited, Wolverhampton—Improved galvanised iron plates and exposition of the method of manufacture.

John Moncrieff, Perth, Scotland—Water-boiler gauge glasses.

Sydney Smith and Sons, Nottingham—General exhibit of gauges, valves, fittings, &c.

Waterforce Laundry Machine Co., Limited, London—Washing machines.

Shaws, Limited, Manchester—Brush boring machine.

Group 78.—Machines for Working Stone, Clay, and other Minerals.

Thomas C. Fawcett, Leeds—Patent brick and tile pressing machine.

Henry Knowles, London—Knowles's down-draught kilns.

Tilghman's Patent Sand Blast Co., Limited, Sheffield—Patent sand blast apparatus.

Group 79.—Machinery used in the Preparation of Foods, &c.

Joseph Baker and Sons, London—Exhibit of bread, cake, and pastry making machinery, and continuous baking ovens; cracker and biscuit making machinery; plant for manufacture of confectionery; plant for making ice cream; hard and soft cracker and biscuit combined gauging, cutting, and panning machine; lozenge machine; machines for making and refrigerators for preserving ice cream.

Davies and Sneade, Liverpool—Millstones for the preparation of cereals.

Jas. Johnston and Co., Manchester—Baking oven and dough mixer.

DEPARTMENT G.—TRANSPORTATION.

Group 80.—Railways, Railway Plant and Equipment.

Great Western Railway Co., London—Express engine, vacuum brake, rail sections, and pictures.

Midland Railway Co., Derby—Photographs of rolling stock.

London and North-Western Railway Co., London—Carriages, compound express locomotive, model of gravity yard, models of Trevithick Engine and "Rocket," Webb signal system, and electric staff and ticket apparatus; electric tube-cutting machine; section of permanent way.

Engineering, Limited, London—Engravings.

Sir John Fowler, K.C.M.G., and Sir Benjamin Baker, K.C.M.G., London—Model of Forth-bridge.

Leverett and Ramsay, Durban, Natal—"Fluke" carriage door.

John Brown and Co., Limited, Sheffield—Locomotive buffer.

Group 83.—Vehicles and Methods of Transportation on Common Roads.

Warman and Hazlewood, Limited, Coventry—Bicycles.

Morgan and Co., Limited, London—Four-in-hand drag, full perch mail phaeton, canoe-shaped landau, rustic dog-cart, "moroi" car, lap-ropes, &c.

T. H. Brigg, Bradford—Method of attaching horses to vehicles.

Woods and Son, St. Ives—"Ivo" two-wheeled cart.

Henry Wilson, Dublin—Dray harness, heavy van harness.

Thomas Briggs, Manchester—Patent tip cart and brake.

J. Carver, Walsall—Driving whips, hunting crops, cutting whips, bridles, lines and girths, racing whips, various woods used for whips.

H. Peat and Co., London—Four-in-hand harness; brougham harness: tandem harness; lady's saddle; travelling saddle; hunting saddle; race saddle; bridles; horns, flask, sandwich-box, and cases; artificial flowers; crests and monograms.

Martin and Martin, London—Hunting and pack saddles; lady's saddle; bridles; monograms and crests; girths; head-stall collars; riding leggings; silk painted rosettes; watch-cases, horn, flasks, &c.

B. Cope and Sons, Limited, Bloxwich—Bridles, &c.; patent safety stirrup; bits.

Metallic Tube and Flask Co., Limited, Birmingham—Weldless cold drawn steel tubes.

Quadrant Cycle Co., Birmingham—Bicycles; tricycles.

Raleigh Cycle Co., Limited, Nottingham—Bicycles.

Swaine and Adeney, London—Whips, &c.

Mrs. French-Sheldon, London—Palanquin and camp outfit.

Premier Cycle Co., Limited, Coventry—Bicycles; tricycles, and cycle parts.

Institute of British Carriage Manufacturers, London—Historical collection of drawings and models.

Saint John Ambulance Association, London—Litters, stretchers, and ambulance material; ambulance.

Group 85.—Vessels, Boats—Marine, Lake, and River Transportation.

Thomas Cook and Son, London—Models illustrating travel; complete set of maps and literature.

Cunard Steamship Co., Limited, Liverpool—Models of steamships.

Donald Currie and Co., London—Models, charts, and photographs.

Suter, Hartmann, and Rahtjen's Composition Co., Limited, London—Anti-corrosive and anti-fouling compositions.

J. W. Weeks and Son, Liverpool—Heated surface composition.

Belfast Ropework Co., Limited, Belfast—Ropes, cordage, lines, &c.

Thames Iron Works and Shipbuilding Co., Limited, London—Models of warships; naval and service ship models; Hone's patent excavator and elevator.

William Mills, Sunderland—Engaging and disengaging gear for ships' boats.

Laird Brothers, Birkenhead—Models and pictures of vessels; naval and service ship models.

Joseph F. Green, London—Patent hydraulic steam life-boat.

Mrs. Joicey, Stockfield-on-Tyne—Original *Grace Darling* lifeboat.

Peninsular and Oriental Steam Navigation Co., Limited, London—Models of steamers and maps.

William Simons and Co., Renfrew, Scotland—Models of dredgers, elevating platform, ferry steamer.

Union Steamship Co., Limited, London—Models of royal mail steamers *Scot* and *Mexican*.

Heslop and Co., Limited, Wakefield—Pressed steel life-boat.

R. and W. Hawthorn, Leslie, and Co., Limited, Newcastle-on-Tyne—Naval and steamship models.

R. J. Turk, Kingston-on-Thames—Thames pleasure skiff.

White Star Line, Liverpool—Ship models, india-rubber tiling, sections of rooms, &c.

John Brown and Co., Limited, Sheffield—Purves's ribbed steel boiler tubes, hydraulic-flanged boiler front, and Purves's ribbed steel furnace flues; spare crank shaft for *Rurik*, electro-coated shafting, propeller blade of *City of Paris*.

Denny and Co., Dumbarton, Scotland—Model of quadruple expansion engine, and sectional moving diagrams; models of engines.

Combe, Barbour, and Combe, Limited, Belfast, Ireland—Thread, rope, cordage, binding, twine, &c.

Wm. Denny and Brothers, Dumbarton, Scotland—Models and photographs of steamers.

Group 86.—Naval Warfare and Coast Defence.

Maxim Nordenfelt Guns and Ammunition Co., Limited, London—Model of disappearing platform, semi-automatic guns and gun mounts, automatic machine guns, carriage.

James and George Thomson, Limited, Clydebank—Models of war-ships.

Yarrow and Co., London—Models of torpedo boats; model of the *Opale*.

Sir W. G. Armstrong, Mitchell, and Co., Newcastle-on-Tyne—Half model of H.M.S. *Victoria*; full model of Argentine cruiser.

John Brown and Co, Limited, Sheffield—Armour plate.

John Coryton, London—Historical collection.

DEPARTMENT H.—MANUFACTURES.

Group 87.—Chemical and Pharmaceutical Products—Druggists' Supplies.

J. and E. Atkinson, London—Essences, perfumery, toilet powders, soaps, cosmetics, hair tonics, creams.

Thomas Bigg, London—Sheep dip.

Patent Borax Co., Birmingham—Soap, borax.

Alfred Bishop and Sons, Limited, London—Granular effervesences.

Burroughs, Wellcome and Co., London—Ear drum, hypodermic syringe.

Brunner, Mond and Co., Northwich, Cheshire—Alkali, soda crystals, soda, ammonia, bleaching powder.

Burroughs, Wellcome and Co., London—Medicine cases and chests, tabloids, feeding-bottle, inhaler.

T. Christy and Co., London—Kola.

The Crown Perfumery Co., London—Perfumery, toilet soaps, sachet powder.
 F. C. Calvert and Co., Manchester—Carbolic preparations, disinfectants, salve, ointments, acid.
 J. Gosnell and Co., London—Perfumery soaps.
 Thomas Jackson, Manchester—Cachoux.
 Ness and Co., Darlington—Liquid sheep dip.
 Quibell Brothers, Newark-on-Trent—Liquid and powdered sheep dip, gelatine, soaps, glue.
 James Pain and Sons, London—Pyrotechnics.
 W. Ransom and Son, Hitchin, London—Essential oils, pharmaceutical appliances.
 Stevenson and Howell, London—Essential oils, extracts, essences, perfumery.
 T. and H. Smith and Co., Edinburgh—Chemical products of a pharmaceutical nature.
 Sarah Sprules, Wallington, Surrey—Essential oils, essences, perfumery, lavender water.
 Stafford Allen and Sons, London—Essential oils, express oils.
 Richard Usher, Bodicote—Rhubarb.
 The United Alkali Co., Limited, Liverpool—Alkalies, chloride of lime, caustic soda, potash, fertilizers.
 Lever Brothers, Limited, Port Sunlight, near Birkenhead—Soap (sunlight).
 Curtis's and Harvey, London—Sporting and rifle powder.
 Birmingham Vinegar Brewery Co., Limited, Birmingham—Flavoring essences.
 Bryant and May, Limited, London—Matches.
 Cyona Co., Limited, London—Veterinary tincture.
 Joseph Edmunds, London—Vanilla pods and essences of vanilla.
 Tomlinson and Hayward, Lincoln—Liquid sheep dip.
 Mouilla Potash Liquid Toilet Soap Co., Limited, London—Mouilla liquid toilet soap.
 Newball and Mason, Nottingham—Extracts of roots.
 Lever Brothers, Limited, Port Sunlight—Artistic display of "Sunlight" soap.
 James Alexander and Co., Limited, London—Soaps, toilet and medical.

Group 88.—Paints, Colours, Dyes, and Varnishes.

P. and J. Arnold, London—Inks, mucilage.
 Lewis Berger and Sons, Limited, Homerton—Pigments, varnishes, dry colours and ready-mixed paints; ready-mixed house paint; artists' tube colours.
 Day and Martin, London—Boot blacking.
 J. B. Duckett and Co., Heeley, Sheffield—Ink powder, writing ink.
 Madderton and Co., Loughton, Essex—Artists colours.
 Winsor and Newton, Limited, London—Artists colours, brushes.
 Harrison and Son, Hanley—Colours, glazes, enamel for potters' use, &c.

Group 89.—Typewriters, Paper, Blank Books, Stationery.

Thomas B. Ford, High Wycombe—Blotting paper.

Cotterell Brothers, Bristol—Wall paper.
 Joseph Gillott and Sons, Birmingham—Pens.
 Jeffrey and Co., London—Artistic wall paper; embossed leather; leather paper.
 Chas. Knowles and Co., London—Art wall paper.
 Wm. Woollams and Co., London—Wall paper.

Group 90.—Furniture of Interiors, Upholstery, and Artistic Decoration.

Miss E. Malet, London—Coffer-shaped box.
 Royal School of Art Needlework, London—Cromwellian chair; screen, Louis XVI.
 Working Ladies' Guild, London—Bureau, antique design; chest as supplied to Her Majesty the Queen.
 Miss Emanuel, Cape Town—Heather screen.
 Mrs. Anna Lea Merritt, London—Wall decorations.
 Burroughes and Watts, Limited, London—Billiard table, eureka steel block cushion.
 Collinson and Lock, London—Artistic furniture.
 Gregory and Co., London—Artistic furniture.
 Hoskins and Sewell, Birmingham—Metallic bedsteads.
 Hampton and Sons, London—Furniture, reproduction of the Hatfield-house banquet hall.
 Johnstone, Norman, and Co., London—Patent dining table.
 London Fabric Printing Co., London—Printed cretonnes, printed floor covering, printed wall coverings, printed curtains, (various shades).
 George Roberts, Sheffield—Antique carved oak; decorative furniture.
 Winfields, Limited, Birmingham—Brass bedsteads; brass lectern.
 George Wright and Co., London—Billiard tables, fittings.
 Johnstone, Norman, and Co., London—Furniture in Victoria-house.
 Hoskins and Sewell, Birmingham—Cribs, bassinette.
 McCaw, Stevenson and Orr, Limited, Belfast—Glacier window decorations.

Group 91.—Ceramics and Mosaics.

Miss E. Lewis, London—Underglazed tile, framed.
 Willam Ault, Swadlincote—Artistic pottery.
 T. C. Brown-Westhead, Moore and Co., Stoke-on-Trent—Cauldon china and earthenware; earthenware.
 The Coalport China Co., Limited, Coalport, Shropshire—China.
 Doulton and Co., Burslem, Staffordshire—Pottery-ware, china, earthenware.
 Doulton and Co., Lambeth, London—Stone-ware, artistic pottery, colossal group in terra-cotta, two large terra-cotta panels.
 Moore Brothers, Longton, Staffordshire—Artistic chinaware.
 Maw and Co., Limited, Jackfield, Shropshire—Tiles, mosaics, architectural faïence pottery.
 Thomas Peake, Tunstall—Bricks, tiles, terra-cotta.
 Worcester Royal Porcelain Co., Limited, Worcester—Royal Worcester ware.

Godwin and Hewitt, Hereford—Tiles.
 Gibson and Sons, Burslem—Jet goods, plain and decorated.
 Miss Ada E. Goodwin, Derby—Plaque of Roman design.
 Miss M. Butterton, London—Plaque flowers.
 Miss F. Lewis, London—Dessert service.
 Arup Brothers, London, W.—Terra-cotta ware; interior house decorations.

Group 92.—Marble, Stone, and Metal Monuments. Mausoleums, Mantels, &c., Caskets, Coffins, and Undertakers' Furnishing Goods.

Collinson and Lock, London—Carved marble mantel pieces.
 P. J. O'Neill and Co., Dublin, Ireland—Celtic cross.
 Thomas Pettigree, Navan—Marble and stone monuments.
 J. Gonella and Co., Dundee—Marble busts.
 Thomas M. H. Flynn and Co., Bessbrook, Ireland—Monuments and crosses.

Group 93.—Art Metal Work—Enamels, &c.

Mrs. D. Watson, London—Glove box and handkerchief box.
 Mrs. Ernest Hart, Bantry, Ireland—Brass altar furniture; metal work.

Group 94.—Glass and Glassware.

A. B. Daniell and Sons, London—Sculptured glass.
 Clarke's Pyramid and Fairy Light Co., Limited, London—Centre pieces in china and glass.
 Cannington, Shaw, and Co., Limited, St. Helens—Glass bottles and jars.

Group 95.—Stained Glass in Decoration.

Henry Holiday, London—Stained glass.
 Winfields, Limited, Birmingham—Stained glass.

Group 96.—Carvings in various Materials. Artificial Flowers, Fans, &c.

Harry Hems and Sons, Exeter—Wood-carving, sculpture.
 McCreery and Son, Belfast—Irish spinning-wheel for wool, flax, or silk; Irish spinning-wheel.
 Mrs. Ernest Hart, Bantry—Wood-carving by pupils in technical school; wood-carving.
 The Countess of Tankerville, Belford, Northumberland—Walnut dresser, after Flemish 17th century; walnut buffet, after Flemish 16th century; fan handles, plaques for note book, &c.
 Miss Elizabeth E. Packer, Dulwich, London—Copies of sacred columns.
 Miss Lizzie Barr, East Grinstead, Sussex—Oak court cupboard, &c.
 Miss Lucy A. Dobbings, Leeds—Octagonal walnut table.
 Miss Elont, Belford, Northumberland—Walnut dresser, after 17th century.
 Gibson and Co., Limited, Belfast—Jewellery.
Group 97.—Gold and Silver Ware, Plate, &c.
 Goldsmiths' and Silversmiths' Co., London—Gold and silver plated ware; gold caskets.

Gibson and Co., Limited, Belfast—Gold and silver plate.

Mappin Brothers, London—Silver plate; Queen's electro plate; gold caskets.

Ash, Gill, and Co., Birmingham—Specimens of electro depositing.

Edmond Johnson, Dublin—Collection of reproductions of famous gold and silver antiquities of Ireland.

Mrs. Ernest Hart, Bantry—Irish woollens.

Group 98.—Jewellery and Ornaments.

Gibson and Co., Limited, Belfast—Diamonds.

Goldsmiths' and Silversmiths' Co., London—Clocks, diamonds, jewellery, gold caskets.

Neilson, Shaw and Macgregor, Glasgow—Highland ornaments.

Diamond Cutting Co., London—Diamonds.

Mrs. Ernest Hart, Bantry—Jewellery, goldsmiths' and silversmiths' work.

E. M. Goggin, Dublin—Jewellery and ornaments.

Group 99.—Horology—Watches, Clocks, &c.

John Smith and Sons, London—Bells, chimes, clocks.

Goldsmiths' and Silversmiths' Co., London—Sea chronometers, watches.

Group 100.—Silk and Silk Fabrics.

Sir Jacob Behrens and Sons, Manchester—Silk yarns.

Collinson and Lock, London—Brocades, damasks.

S. Courtauld and Co., Limited, London—Silk crêpe, gauzes, costumes.

Grout and Co., London—Silk crêpe, silk crepons.

Francis Hinde and Sons, Norwich—Crêpe goods.

Group 101.—Fabrics of Jute, Ramie, and other Vegetable and Mineral Fibres.

William Cleghorn, jun., Dundee—Jute cloth and yarn.

John Barry, Ostlere and Co., Limited, Kirkcaldy—Linoleum, oil-cloths.

Combe, Barbour and Combe, Limited, Belfast—Manufactured flax, sisal, jute, ramie, and hemp.

Group 102.—Yarns and Woven Goods of Cotton, Linen, and other Vegetable Fibres.

Barlow and Jones, Limited, Manchester—Linen fabrics; cotton fabrics.

Wm. Barbour and Sons, Limited, Lisburn—Linen thread; gilling nets; embroidery.

Sir Jacob Behrens and Sons, Manchester—Cotton yarn.

J. S. Brown and Sons, Belfast—Linen goods; table linen.

Brookfield Linen Co., Limited, Belfast—Linens; table linens.

John Brown and Son, Glasgow—Madras and crete muslin curtains; Cotton fabrics.

Fenton, Connor and Co., Belfast—Bleached and unbleached linens.

Chas. Fox and Son, Leeds—Linens.

Ferguson Brothers, Carlisle—Cotton goods; sateens.

Finlayson, Bousfield and Co., Johnstone, Scotland—Linen thread.

John King and Son, Glasgow—Scotch window hollands; cotton.

Wm. Liddell and Co., Belfast—Linen goods; table linen; threads.

Henry Matier and Co., Belfast—Cambric and linen handkerchiefs.

Old Bleach Linen Co., Randalstown, Ireland—Linen.

J. N. Richardson, Sons and Owden, Limited, Belfast—Linen goods.

Robertson, Ledlie, Ferguson and Co., Limited, Belfast—Table damask; linen; cambric.

Swainson, Birley and Co., Preston—Plain and fancy cotton goods; shirting, muslin, &c.

Turnbull and Stockdale, Manchester—Machine and hand-painted cretonnes; velveteens.

Combe, Barbour and Combe, Limited, Belfast—Thread and yarn.

Mrs. Ernest Hart, Belfast—The Kells Art Linens; linen.

Langdale Linen Industry (Miss Smith), Ambleside—Specimens of hand-spun and hand-woven linen.

Barlow and Jones, Limited, Manchester—Cotton fabrics; linen fabrics.

Group 103.—Woven and Felted Goods of Wool, and Mixtures of Wool.

Apperly, Curtis and Co., Stroud (Gloucestershire)—Woollens, doeskins, cassimeres, serges, chevots, beavers.

Thomas Bontor and Co., London—Axminster carpets.

The Cravenette Co., Limited, Bradford—Woollen waterproofs.

Dormeuil Frères, London—Wools, cassimeres, worsted and linens, men's wear.

Wm. Fison and Co., Burley in Wharfedale—Serges. Hudson, Sykes and Bousfield, Leeds—Woollen and worsted goods, cassimeres.

Charles Hooper and Co., Stonehouse, Gloucestershire—Cassimeres, flannels, doeskins, carriage, livery, piano, gloving, billiard cloths.

J. Graham Henderson, Hawick, Scotland—Traveling robes, tweeds.

Isaac Carr and Co., Bath—Woollens, beavers, meltons, elysians, covers, coatings, worsteds.

Irish Woollen Manufacturing and Export Co., Limited, Dublin—Irish woollens.

Marling and Co., Limited, Stroud, Gloucestershire—Carriage and livery cloth, suitings, trouserings, beaver, worsteds, doeskins, broadcloth.

Neilson, Shaw and Macgregor, Glasgow—Rugs, shawls, carpets, tweeds, and taitan fabrics.

B. Priestley and Co., Idle, Yorkshire—Silk and wool dress fabrics, veils, Priestley's cravenette, Priestley's silk warp Henrietta.

Turberville Smith and Son, London—Axminster carpets.

Ward and Taylor, Bradford-on-Avon—Tweeds, Bedford cords, suitings, covert coatings.

Yates and Company, Limited, Wilton, Wilts—Axminster carpets.

A. and J. Macnaughton, Pitlochry—Scotch tweeds, homespun for ladies.

Mrs. Ernest Hart, Bantry—Homespun, woollens.

Women of South Wales—Sample of Welsh flannels made by women.

Miss R. M. Garrett, London—Hand-made carpets.

Lady Aberdare, South Wales—Welsh flannels.

Group 104.—Clothing and Costumes.

Athlone Woollen Mills Co., Athlone—Ready-made clothing; dress materials.

Cartwright and Warners, Limited, Loughborough—Cashmere, silk, and wool underclothing.

Cooksey and Co., London—Hats.

E. and H. Hummel and Co., London—Hosiery; silk underwear; gloves.

Irish Industries Association, Dublin—Ready-made clothing; collective exhibit of knit goods, woollens, linens, &c.

Lincoln, Bennett and Co., London—Hats; helmets.

John Lobb, London—Boots; shoes.

Wm. Lewis and Sons, London—Silk and other underwear; gloves; shirts.

Wm. Morley and Gray, London—Knee and garterless silk and wool hose.

F. J. Martin and Co., London—Gloves; glove and boot clasps.

Neilson, Shaw and Macgregor, Glasgow—Knit woollens.

Ormes, Upsdale and Co., London—Silk gloves and mitts.

W. Shingleton, London—Patent safety riding habit. Smyth and Co., Limited, Balbriggan—Balbriggan hosiery.

Macqueen and Co., London—Felt and silk hats and helmets.

R. Walker and Sons, Leicester—Woollen hosiery and underwear.

Mrs. Ernest Hart, Bantry—Ulsters, sanitary underwear, Court dress, poplin, tea gown, tailor-made costumes, cape, black Irish poplin, jacket, ladies' hand-sewed underclothing, hand-knit hosiery, &c. (process shown.)

Women of Anglesey—Hand-knitted stockings.

W. H. Grant and Co., Coventry—Braids and caps, silk suspenders, silk garters, silk badges.

Miss Adean, Holyhead—Dress figure in costume.

Group 106.—Laces, Embroideries, Trimmings,

The Royal School of Art Needlework, London—Copy of old battalion cover, handkerchief sachet, brush cover to match; blotter, copy, Spanish, on vellum; casket, copy, old English; kid frame, gold work; specimens of curtains ordered by Her Majesty, Tapestry-room, Windsor Castle; Pomona wall hanging.

Ladies' Work Society, London—Cushion; photograph screen and mirror frame, designed by Princess Louise.

- Miss C. D. Hainsworth, Starbeck, Harrogate—Nightdress satchet and brush bag.
- Mrs. L. Halsham, Leeds—Shepherd and sheepfold by Lady C. T. Clive, governess to the Queen.
- Mrs. C. Holiday, London—Embroidered portière.
- Women of South Wales—Welsh coverlet, by women at home.
- Benton and Johnson, London—Gold and silver laces.
- H. Milward and Sons, Limited, Redditch, Worcestershire—Needles.
- S. Peach and Sons, Nottingham—Lace and silk curtains.
- R. Turner and Sons, Redditch, Worcestershire—Hair-pins, needles and pins, crochet hooks; needles of all kinds, needle-cases; steel pins of all kinds.
- Superiores, Convent of Mercy, Abingdon—Hood of cope.
- Miss L. Stone, Streatham—Embroidered bamboo screen, mounted.
- Miss Thompson, Lancaster—Tea cloth.
- Miss E. G. Tobin, Eastham-house, Cheshire—Antependium embroidery, copy of old christening embroidery, Shropshire boy-smock embroidery.
- Miss E. Walker, Birmingham—One sample of needle-work.
- Miss A. Walmsley, Lucerne—Table cloth embroidered.
- Miss M. E. Westrope, Bristol—Dinner cloth, melon-seed work.
- Miss M. Wheeler, Bridgenorth, Table cover, embroidered.
- Miss Isabella Jay, London—Fans, copied.
- Miss Helen Arding, London—Gauze fan leaves.
- Miss M. A. Clarke, Manchester—Embroidered velvet mantel border.
- Mrs. Cope, London—Copy, Munich book cover, 14th century.
- Miss Digby, London—Banner, St. Cecilia, church work.
- Miss J. Dixon, Harrogate—Table centre.
- Miss J. M. Dixon, Harrogate—Portière, worked in jewels and silk.
- Miss E. M. Gardner, Ilfracombe, Devon—British moths, worked in silk, &c.
- Miss A. Garnett, Crown Hotel, Windermere—Cushion cover; tea cloth.
- Miss Mary E. Anderson, Grantham, Lincolnshire—Doyleys, fine netting on fine linen.
- Miss A. Batt, Witney, Oxon—Four pairs embroidered baby shoes.
- Bavin and Ormiston, Reading—Sofa cushion, stole.
- Miss M. Buckle, London—Cottage piano front.
- Mrs. Herbert, Devonshire—Specimens of lace.
- Lady Trevelyan, Devonshire—Specimens of reproduction of Italian lace, &c.
- L. Stanton, Towcester, Northamptonshire—Northamptonshire real lace, 18th century.
- C. and T. Lester, Bedford—Hand-made pillow-case and specimens, &c.
- Lady Connell, Buckinghamshire—Black silk fan cover, black silk edging, narrow baby lace, handkerchief border, white; old Buckinghamshire lace.
- Miss Radford, Sidmouth—Handkerchief and lappets in Honiton lace, &c.
- Mrs. Fowler, Honiton, Notts.—Specimens of Honiton, &c.
- The Royal School of Art Needlework, London—Fourfold screen; Elizabethan Bible and screen; cushion, old Battalion embroidery; yellow satin coronet; copy of old Battalion stool.
- Mrs. Ernest Hart, Bantry—Limerick lace and hand-painted fan, fringes of polished Kells thread, Limerick lace (Irish), Kells lace (Irish), crochet, point and other lace (Irish); lace, embroidery.
- Irish Industries Association, Dublin—Collective exhibit of laces.
- Irish Industries Association (Lady Aberdeen's village), Dublin—Collective exhibit of embroideries; collective exhibit of cut work; collective exhibit of vestments.
- Miss L. Macgregor, London—Needlework done at Widows' Industrial School.
- Miss L. Macpherson, London—Embroidered curtains.
- Mrs. J. Mercier, Tewkesbury—Chemise, chalice veil, socks, towel, pillow case.
- Misses Molineaux, London—Six pairs of baby shoes.
- Miss May Morris, London—Coverlet for bed.
- Miss M. G. Noble, Hull—Patchwork quilt, 15,682 pieces.
- Mrs. K. M. Paget, London—Two pieces copy of old Turkish embroidery.
- Misses Felise Palmer, Windsor—Cushion cover, Greek lace cushion cover.
- Mrs. Walter Pye, Viewfield—Portière.
- Miss Randall, Slough—Embroidered quilt.
- Miss R. Russell, London—Worked pictures.
- Miss M. A. Smith, London—Chair backs, table cloth, fan, blotter.
- Irish Exhibit—Applique, veil, fire screen, tambone, patterns of the run and drawn lace, tatting, Royal Irish guipure, patterns, imitations of antique guipure, patterns.
- Lady Idlesleigh's Committee, Devonshire—Hand-made net, made on pillow with needle.
- Thomas Harper, Redditch, Worcestershire—Needles and fancy needle cases.
- T. H. and J. Muddiman, London—Mantle and costume trimmings.
- J. and J. Cash, Coventry—Bath towels, frillings, embroideries.
- Group 107.—Hair-work, Coiffures, and Accessories of the Toilet.*
- Hindes, Limited, Birmingham—Toilet brushes.
- S. R. Stewart and Co., Aberdeen, Scotland—Combs, shell, horn combs, horn cups, shoe horns, paper cutters, horn ornaments and horn dust.
- Group 108.—Travelling Equipments—Valises, Trunks, Toilet-cases, Fancy Leather-work, Canes, Umbrellas, Parasols, &c.*
- Robert Bryant, London—Wood and leather gun and pistol cases, courier bags, pouches and belts, cartridge magazines.

Wm. White and Son, Glasgow—Clay tobacco pipes.
 Albion Clay Co., Limited, Woodville, Burton-on-Trent—Sykes patent joint pipes.
 Mappin Brothers, London—Dressing and travelling bags.

Mrs. Ernest Hart, Bantry, Ireland—Canes carved in bog oak.

Group 109.—Rubber Goods, Caoutchouc, Gutta-Percha, Celluloid, and Zylonite.

Anderson, Anderson and Anderson, London—Rubber gloves, waterproof clothing, hunting, fishing and yachting suits.

Group 111.—Leather and Manufactures of Leather.
 Miss Bartlett, Liverpool—Blotting-book and folding writing-case in embossed leather.

Miss M. A. Bassett, Leighton Buzzard—Specimens of leather work, blotting-book cases, &c.

Mrs. E. C. McClure, London—Ancient Cromwellian chair (re-covered).

Mrs. Ottman, Stonehaven, N.B.—Gum: book with coat of arms.

Miss Sophia Smith, Kirby Lonsdale—Screen panel.
 Dorothy Wheatley, London—Arm-chair (hall) embossed with coat of arms.

Wm. Woollams and Co., London—Leather wall decorations.

Group 113.—Material of War, Ordnance, and Ammunition, Weapons and Apparatus of Hunting, Trapping, &c., Military and Sporting Small Arms.

Eley Bros., Limited, London—Ammunition.

W. W. Greener, Birmingham—Sporting guns and rifles.

F. Joyce and Co., Limited, London—All kinds of ammunition for light arms.

Charles Lancaster, London—Guns, sporting hammer, hammerless and ejector rifles.

Schultze Gunpowder Co., Limited, London—Smokeless gun powder.

W. and C. Scott and Son, Birmingham—Revolvers and sporting guns.

Group 114.—Lighting Apparatus and Appliances.
 Clarke's Pyramid and Fairy Light Co., Limited, London—Lamps.

C. H. Worsnop, Halifax—Lamps.

Moore Bros., Longton, Staffordshire—Lamps.

James Stott and Co., Oldham—Gas burner and governors.

General Electrical Co., Limited, London—Electroliers and brackets.

Group 115.—Heating and Cooking Apparatus and Appliances.

Ewart and Son, London—Water heater and gas regulator.

Joseph Baker and Sons, London.—Bread-baking tins, pastry brushes, icing syringe and tubes, brides' cake stands, brides' cake knives, palette and dough knives, thermometers for cooking, egg and cake beaters, tin jelly, pudding, and cake moulds, copper moulds, purée strainer.

Group 119.—Vaults, Safes, Hardware, Edge Tools, Cutlery.

W. T. Staniforth, Sheffield—Pocket cutlery, farmers' and hunters' knives, razors.

The Tubular Lock Syndicate, Limited, London—Patent tubular reversible mortise locks.

G. Wostenholm and Son, Limited, Sheffield—Pen, pocket and sporting knives, table cutlery, razors and scissors.

Mappin Bros. London, cutlery.

Group 121.—Miscellaneous Articles of Manufacture not heretofore classed.

Working Ladies' Guild, London—Bureau, grotesque design; chest, as supplied to her Majesty the Queen; folding heart-shaped table.

DEPARTMENT J.—ELECTRICITY.

Group 123.—Apparatus for Electrical Measurements.

James White, Glasgow—Electro-magnetic balances, "Kelvin."

Group 124.—Electrical Batteries: Primary and Secondary.

Epstein Electric Accumulator Co., Limited, London, —Storage batteries.

Group 126.—Transmission and Regulation of the Electrical Current.

General Electric Co., Limited—High insulation switches, and other incandescent house fittings.

Group 133.—Electric Telegraph and Electric Signals.
 British Government Postal Telegraph Department, London—Collection of modern telegraphic apparatus.

Group 137.—History and Statistics of Electrical Invention.

British Government, Postal Telegraph Department, London—Historical telegraphic apparatus.

Corporation of Birmingham, Birmingham—Original Woolwich dynamo.

Group 138.—Progress and Development in Electrical Science and Construction, as Illustrated by Drawings and Models of various Countries.

General Electric Co., Limited, London—Carbons for arc lamps.

DEPARTMENT K.—FINE ARTS.

Group 139.—Sculpture.

Edward Onslow Ford, A.R.A., London—Statue of Henry Irving as "Hamlet"; Right Hon. W. E. Gladstone; General Gordon on Camel.

George Frampton, A.R.A., London—Caprice; Singing Girl; St. Christina.

W. Goscombe John, London—Morpheus; Study of a Female Head.

Sir Frederick Leighton, Bart. P.R.A., London—Needless Alarm; The Sluggard.

F. W. Pomeroy, London—Dionysius; Giotto.

John M. Swan, A.R.A., London—Lioness; Tigress; Panther.

Hamo Thornycroft, R.A., London—The Mower ; Teucer ; Edward I. ; Putting the Stone.

Group 140.—Paintings in Oil.

Miss Anna Alma Tadema, London—A Portrait.

L. Alma Tadema, R.A., London—A Dedication to Bacchus ; An Audience at Agrippa's ; The Sculpture Gallery.

Mrs. Alma Tadema, London — Battledore and Shuttlecock ; Fireside Fancies ; Always Welcome.

W. H. Bartlett, London — Practising for the Swimming Match ; The Village Billiard Players ; A Wrack Harvest.

G. H. Boughton, A.R.A., London—Dancing Down the Hay ; Winter Sunrise ; Love in Winter.

Frank Bramley, A.R.A., Penzance—A Hopeless Dawn ; For of Such is the Kingdom of Heaven.

Frank Brangwyn, London—The Convict Ship ; Pilots, Puerta de Passages.

Frederick Brown, London—When the Evening Sun is Low.

Lady Butler—The Roll Call.

William Carter, London — Portrait of William Sheppard Hoare, Esq. ; Portrait of G. Trenchard Cox, Esq.

James Charles, Bosham—In Memory of ; Left in Charge ; A Frosty Morning ; Jack at Home.

George Clausen, R.I., Newport — Ploughboy ; Brown-eyes ; A Woman of the Fields ; The Breakfast Table ; Ploughing.

Frank Dicksee, R.A., London — The Passing of Arthur ; The Redemption of Tannhauser.

Alfred East, R.I., London—An Angry Dawn ; The Arms of Peace.

S. Melton Fisher, London—A Summer Night.

Horace Fisher, London—The Card Players ; A Mid-day Rest.

Morley Fletcher, London—Shadow of Death.

Mrs. Stanhope Forbes, London—The Witch.

Stanhope A. Forbes, A.R.A., London—Forging the Anchor ; Soldiers and Sailors.

T. F. Goodall, Dulwich—The Last of the Ebb ; Great Yarmouth from Breydon Water ; When the Sun Sets, and the Moon Rises.

T. C. Gotch, London—My Crown and Sceptre.

A. C. Gow, R.A., London—Queen Mary's Farewell to Scotland.

Peter Graham, R.A., London—Caledonia Stern and Wild ; The Hamlet on the Cliff.

Arthur Hacker, A.R.A., London—Christ and the Magdalen ; Portrait of Miss W. ; Fire Fancies.

Professor H. Herkomer, R.A., Bushey—The Last Muster ; Miss Katherine Grant ; Entranced.

J. C. Hook, R.A., Farnham—Wreckage from the Fruiter ; Little to Earn and Many to Keep.

Colin Hunter, A.R.A., London—The First Plunge of Niagara ; Fishers of the North Sea ; The Island Harvest.

G. W. Joy, London—Lady Daffodil ; Danaids.

Yeend King, R.I., London—Autumn Wooing ; The Lass that Loved a Sailor ; A Grey Day in July.

H. H. La Thangue, Bosham—Leaving Home ; A Gaslight Study.

John Lavery, Glasgow — Katherine and Esther, Daughters of Lord McLaren ; An Equestrienne.

B. W. Leader, A.R.A., Guildford, Surrey—Conway Bay and Carnarvonshire Coast ; When the Sun is Set.

Sir Frederick Leighton, Bart., P.R.A., London—Hercules Wrestling with Death for the Body of Alceste ; Garden of the Hesperides ; Perseus and Andromeda ; Portrait of Captain Burton.

Sir James D. Linton, P.R.I., London—Victorious ; The Benediction.

William Logsdail, London—Ninth of November ; Sunday in the City ; Venice from the Public Garden ; Flower Gathering, South of France.

Mouat Loudan, London—Fish Market, Cornwall.

Seymour Lucas, A.R.A., London—St. Paul's ;

Louis XI.

Robert W. Macbeth, A.R.A., London—Stag Hunting in a Sea Fog ; The Fen Farm.

Mrs. Anna Lea Merritt, Andover—Eve.

Sir John Everett Millais, Bart., R.A., London—The Ornithologist ; Halcyon Weather : The Last Rose of Summer ; Sweet Emma Morland ; Linger- ing Autumn ; Shelling Peas ; Bubbles.

Miss Clara Montalba, R.W.S., Venice—A Thames Barge off Chelsea.

Albert Moore (the late), London—A Reverie.

Henry Moore, R.A., London—Storm Brewing ; St. Alban's Race ; Sunset after a Storm.

P. R. Morris, A.R.A., London—Sons of the Brave ; Fête Dieu, Dieppe, Normandy ; Edward I. de- manding Allegiance to the First Prince of Wales.

David Murray, A.R.A., London—The River Road ; A Mangold Field ; Season of Mists and Mellow Fruitfulness.

W. Q. Orchardson, R.A., London—A Portrait Group.

Walter Osborne, R.H.A., Dublin—The Ferry.

W. W. Ouless, R.A., London—Portrait of T. S. Cooper, Esq., R.A. ; Portrait of Sir Donald Smith, K.C.M.G.

Alfred Parsons, R.I., London—In a Cider Country ; The Flowers Appear on the Earth ; The Voice of the Turtle is Heard in the Grove ; Daylight Dies.

Ernest Parton, London — When Daylight Dies ; Misty Morn ; The Night Ferry.

Miss Henrietta Rae—Eurydice Sinking into Hades.

John R. Reid, London—The Mate of *The Mermaid's Wedding* ; The Yarn.

Briton Riviere, R.A., London—Requiescat ; Daniel ; The Magician's Doorway.

James Sant, R.A., London — Oliver Twist, He Walks to London ; My Lady Dorothy.

J. J. Shannon, London—Portrait of Mrs. Hitchcock ; Portrait of G. Hitchcock, Esq. ; Portrait of Mrs Charlesworth.

Solomon J. Solomon, London—Orpheus.

Adrian Stokes, London — The Setting Sun ; Through the Morning Mist ; Roman Campagna, Sunset ; Early Spring, Roman Campagna.

- Mrs. Adrian Stokes, London—Hail, Mary; Go, Thou must Play Alone, My Boy.
 Marcus Stone, R.A., London—The Gambler's Wife; The Passing Cloud; Two's Company, Three's None.
 Edward Stott, Amberley—Peaceful Evening; The Bathers; The Horse Pond; In an Orchard.
 William Stott (of Oldham), London—Kissing Ring.
 John M. Swan, A.R.A., London—The Fallen Monarch; Maternity.
 Mrs. Annie L. Swynnerton, London—Mater Triumphales; Portrait of Miss Jane Atkinson.
 A. Chevallier Tayler, London—The Encore—Home, Sweet Home; The Pedlar.
 Leslie Thomson, London—The Homeless Sea.
 Wm. Holt Yates Titcomb, Balham—Primitive Methodists, St. Ives, Cornwall; Old Sea Dogs.
 Henry S. Tuke, Hanwell—Sailors Playing Cards.
 J. W. Waterhouse, A.R.A., London—Mariamne Leaving the Prætorium.
 Ernest A. Waterlow, A.R.A., London—Over the Sandhills; The Misty Moon, Isle of Arran; The Night Before Shearing.
 G. Wetherbee, London—Fishermen's Wives; Glad Spring.
 Miss E. Stewart Wood, London—Autumn.
 Henry Woods, R.A., Venice—On the Steps at Scuola, San Rocco.
 W. L. Wyllie, A.R.A., Rochester—The German Emperor and Prince of Wales Inspecting the White Star Steamer *Teutonic* at Spithead, 4th August, 1889; The Port of London; Davy Jones's Locker.
 Chas. W. Wyllie, London—The Brimming River; The Mighty Fallen.

Group 141.—Paintings in Water Colours.

- Mrs. Lillingham, R.W.S.—Old Sussex Cottage.
 L. Alma Tadema, R.A., London—Calling the Worshippers.
 H. Coutts, Windermere—A Sheep Farm in the Duddon.
 Alfred East, R.I., London—Early Night; Northampton.
 Birket Foster, R.W.S., Witley—Ben Nevis.
 Sir John Gilbert, R.A., Blackheath—Richard II. resigning the Crown to Bolingbroke; Conspiracy.
 Andrew C. Gow, R.A., London—Requisitionists.
 Miss Kate Greenaway, London—Title Page "Marigold Gardens;" Little Phyllis, "Marigold Gardens;" My Little Girlie "Marigold Gardens;" Mulberry Bush, "Children's Games;" Game Play, "Hyacinth's Language of Flowers;" Girl Drawing Chaise with Two Children.
 W. Hatherell, R.I., London—Quarter Deck of a P. and O. Steamer; Monaco and Monte Carlo from Roquebrune.
 Edwin Hayes, R.H.A., R.I., London—Fishing Smack Leaving Port.
 J. Henry Henshall, R.W.S., London—Merry Goes the Time when the Heart is Young; In Wonderland.

- Henry George Hine, V.P.R.I., London—Darlstone-head, Dorsetshire.
 Walter Langley, R.I., Penzance—Disaster; Departure of the Fleet.
 Sir James D. Linton, P.R.I., London—Abandoned.
 Tom Lloyd, R.W.S., London—Ferry Boat, Ahoy; The Last Load.
 Henry Moore, A.R.A., London—Bright Morning after a Breeze; Scheveningen: Waiting for the Shrimp Boats.
 Alfred Parsons, R.I., London—Bodenham Church; Somersetshire Hills.
 W. Rainey, Chichester—The Old Vronn; The City Wall.
 Leopold Rivers, London—Harvest Home.
 Lionel P. Snythe, London—The Field of the Cloth of Gold; Summer Holidays.
 E. A. Walton, A.R.S.A., Glasgow—Phyllis.
 W. L. Wyllie, A.R.A., Rochester—Orient Liner *Ormuz*, off the Eddystone.

Group 143.—Engravings, Etchings, and Prints.

- D. Y. Cameron, Glasgow—Frame of Etchings; Frame of Etchings.
 Herbert Dicksee, London—Etchings: Memories; A Tigress; His Majesty; A Wanderer.
 W. Biscombe Gardner, Haslemere—Wood engravings.
 F. Seymour Haden, P.R.P.E., Arlesford—Morning, near Swanage, Dorset; Evening, near Swanage, Dorset; Durlston Head, Dorset Coast; Undercliff, Dorset Coast; Corfe Common, Dorset; A Village Street in Corfe, Dorset; An Inn Kitchen in Corfe, Dorset; Study of Oaks, Chesterfield, Derbyshire.
 Oliver Hall, R.P.E., London—Etchings: A Study of Trees; A Windy Day on Angerton Moss; A Windy Day.
 William Hole, R.S.A., Edinburgh—Etchings: The Wood Sawyers; The Jumping Horse; He is Coming; Don Gaspar de Gusman, Count of Olivarez; Mill on the Yare.
 David Law, London—Etchings: Water Meadows; Silver Birches; Arundel Castle; Birthplace of Burns.
 Leopold Lowenstam, London—Etchings: In a Rose Garden; A Favourite Author; Harvest Festival.
 Robert W. Macbeth, A.R.A., London—Etchings: The Garden of Love; The Spinners; Alonzo Cano; Bacchus and Ariadne; The Cast Shoe, Lynn Ferry; Harbour of Refuge; Plough; Spring; Autumn; Fen Farm (original etching).
 Miss Ethel King Martyn, London—Etchings: Illustrations to Milton's "Lycidas."
 Mortimer Menpes, R.P.E., London—Etchings: Banquet of the Officers of the Archers of St. Adrian; Dorothy; A Captive Persian.
 Gerald Robinson, Leatherhead—Mezzotints: Queen Henrietta Maria; The Burgomaster; Earl Spencer, K.G.; The Parson's Daughter.
 Charles William Sherborn, London—Engravings: Seymour Haden, Esq.; Oliver Cromwell; Shakespeare; Archbishop of Canterbury; Frame of Book Plates; Frame of Book Plates.

Chas. J. Watson, London—Etchings: Cheyne-walk, Chelsea, 1889; Campden, Gloucestershire; St. Jacques, Lisieux; St. Etienne du Mont, Paris; Rue Chanomesse, Paris; Rue St. Martin, Bayeux.

Group 144.—Chalk, Charcoal, Pastel, and other Drawings.

John Charlton, London—An Impending Catastrophe; A Carriage Accident; Halt, Charge of Lancers at Military Tournament; Ware Wire; Ludgate-hill—A Slippery Pavement; A Veterinary Examination; 'T'wixt the Devil and the Deep Sea; Musical Ride of the 17th Lancers; Horse-show: Harness Horses Trotting; Equestrians at a Meet of the Coaching Club, Hyde-park; Waiting for the Queen, Rotten-row; Ladies' Tilting; Meet of the Devon and Somerset Staghouids; Cover for Christmas Number (Sledging).

George Du Maurier, London—Six Pen and Ink Sketches, originals of cuts in *Punch*.

Sir James D. Linton, P.R.I., London—Twelve Illustrations to Shakespeare's "Henry VIII."

W. H. Overend, London—Five Illustrations to In a Conning Tower; The *Shannon* Disabled Returning Home; Shell Bursting in *Majestic's* Battery; The Midshipman Watching the Torpedo; The *Majestic* Ramming the Enemy's Ship.

John M. Swan, A.R.A., London—Tigress Drinking; Puma (female); Lioness Walking; Indian Leopards; Polar Bear.

Sir John Tenniel, London—A Waiting Game; The Queen of the May; Innings Closed; When Greek meets Greek; The Political "Johnny Gilpin."—The Start; —The Finish; William the Wheelman; Will they Work? Back; The White Elephant.

J. R. Weguelin, London—Illustrations to "Anacreon;" illustrations to "Catullus."

From various Groups, 139-145.—Architecture.

Prof. George Aitchison, A.R.A., London—Royal Exchange Assurance, 29, Pall Mall, S.W.; The Arab Hall; Drawing-room; Small Drawing-room; The Hall; New Drawing-room.

R. Rowand Anderson, LL.D., Edinburgh—New Medical School, Edinburgh University; Catholic Apostolic Church, Edinburgh; Dumbane Cathedral; Govan Parish Church; Central Station Hotel, Glasgow; Scottish National Portrait Gallery, Edinburgh; St. Paul's Church, Greenock.

George C. Ashlin, R.H.A., Dublin—Exterior view of St. Colman's Cathedral, Queenstown; Interior view of St. Colman's Cathedral; Exterior view of the O'Connell Memorial Church, Caherciveen, County Kerry.

Aston Webb and E. Ingress Bell, London—Victoria Courts, Birmingham; Metropolitan Life Insurance Society's Offices; Completion of South Kensington Museum; Pevery, Shropshire.

James Brooks, V.P.R.I.B.A., London—Interior looking east, Liverpool Cathedral; West exterior view, Liverpool Cathedral; South-east exterior view, St. Mary's, Woolwich; Extension north-east view, St. Mary's, Hornsey; South-west view, Holy Innocent's, Hammersmith; Mansions, Ruede Bord, Cape Town.

Ernest George and Peto, London—Collingham Gardens Houses, S.W.; East-hill, Ramsgate; 47, Berkeley-square, interior; Shiplake-on-Thames, interior of hall; Shiplake-on-Thames, exterior of hall.

Thomas G. Jackson, A.R.A., London—New front of Brasenose College, in the High Street of Oxford; New Campanile for the Cathedral of Zara, in Dalmatia; New Tower and Spire for St. John's Church, Wimbledon; the New Examination Schools and Buildings for Non-Collegiate Students in the High Street of Oxford; Decorated Case for a Grand Pianoforte.

Alfred Waterhouse, R.A., London—Natural History Museum, South Kensington; National Liberal Club, Thames Embankment.

DEPARTMENT L.—LIBERAL ARTS.

Group 147.—Physical Development, Training, and Condition—Hygiene.

Mrs. Bedford Fenwick, London—English nursing section; bedstead with special springs.

Miss Marion Kimball, London—Surgical models.

Queen Victoria's Institute, London—District nurse's bag.

Miss E. Pincoffs, London—Private nurse's hold-all. International Water and Sewage Purification Co., London—Polarite for water and sewage purification.

Commissioners of Sewers of the City of London, London—Models and drawings of works designed and carried out by Lieut.-Col. William Haywood.

Cremation Society of England, London—Views of crematorium.

Charity Organization Society, London—Publications, &c.

National Health Association, London—Literature.

Ladies' Sanitary Association, London—Literature.

British Women (Mrs. Gordon)—Collection of 600 books.

The Golf Co., St. Andrew's—Golf clubs and balls.

Group 148.—Instruments and Apparatus of Medicine, Surgery, and Prosthesis.

Claudius Ash and Sons, Limited, London—Mineral teeth, dental sundries, dental rubber.

Arthur B. Cruickshank, London—Syringes.

Burroughs, Wellcome and Co., London—Prepared cocoa.

English Dental Specialty Co., Limited, New Barnet—Dental chairs; pin and hollow crown; shaded pink rubber; dental engine; dental instruments.

Fletcher, Fletcher and Stevenson, Limited, London—Urinometer.

Group 149.—Primary, Secondary, and Superior Education.

- Miss Lambert—Paragon needlework.
 Miss Constance Barnard—Kindergarten loom.
 Blackheath High School—Time tables and schemes of work.
 Sheffield High School—Architectural drawings of school.
 G. W. Bacon and Co., London—School maps in English and Spanish.
 Whitechapel Craft School, London—Set of drawings.
 Joseph H. Cowham, London—School books.
 School Board for London, London—Specimens of writing and school work.
 British Government; Science and Art Department, London—Examples of modelling and design; examples of drawing.
 Oxford University Extension, Oxford—Books, travelling library; photographs.
 Tooting College, London—Sixteen copy-books.
 School Board, Glasgow—Plan of school, photographs, &c.
 Miss Agnes Lynch, Kensington, London—Illuminations on vellum.
 Miss A. Osborne Moore—Philograph for teaching drawing.
 Miss Huddleston—"Theoria Harmonica."
 Miss Kerr—"Skeleton celestial globe."
 Mrs. Ernest Hart, London—Carrehma Cross, homespun, educational work.
 St. Joseph's Industrial School, Longsight, Manchester—Wood-carving, designs, &c.
 H.R.H. the Princess of Wales Technical Schools, Sandringham—Collective exhibit.

Group 150.—Books, Libraries, Literature, Journalism.

- Miss Helen Bayly, Florence—Ten volumes of Shakespeare, in cut leather.
 Mrs. Ottman, Stonehaven, N.B.—Book-cover and coat of arms.
 Miss Birkenwith, London—Books, bound and tooled.
 Miss S. T. Prideaux, London—Bindings in various kinds, leather, and embroidered.
 Miss M. A. Bassett, Leighton Buzzard—Specimens of leather work.
 Miss Noedel, Sandringham—Blotter of oak, with panel, cut and embossed leather.
 Mrs. H. Brownlow, Cambridge—Embroidered book-covers.
 Miss S. Firth, Kirby Lonsdale—Books bound in tooled and cut leather.
 Miss H. Bayly, Florence, Italy—Blotters, card cases, &c., in leather.
 Miss Daniell, Aldershot—Record of work among soldiers.
 Associated Workers' League, London—Book.
 London Bible and Domestic Female Mission, London—Bible Women and Nurses.

- Francis Martin, England—Elizabeth Gilbert, and her work for the blind.
 Sophia G. Wintz, England—Our Blue Jackets.
 Rev. J. G. Figgis, London—Countess of Huntingdon and her connexion.
 Miss Hubbard, England—English Women and their work in Queen Victoria's reign.
 Girls' Friendly Society.
 A. T. Vanderbilt, England—What to do with our Girls.
 Alice Meynall, England—The Poor Sisters of Nazareth.
 Mrs. Spurgeon, England—Book Fund and its work.
 Ladies' Union of Workers, Liverpool—Women Workers (papers).
 Society of Friends, England—Extracts from Minutes of 1891.
 Women of Melbourne, Melbourne—Work of private persons and societies.
 Royal School of Art Needlework, Kensington, London—Books bound in vellum and illuminated.
 G. W. Bacon and Co., London—Collection of charts, drawings, &c.
 Sander and Co., St. Alban's—Sander's meichenbachia, work on orchids.
 Leo Culleton, London—Genealogical table.
 The Art Union of London, London—Works of art, engravings, etchings, statuettes, &c.
 C. E. Clifford and Co., London—Engravings, etchings, &c.
 Decorative Art Journals' Co., Limited, Manchester—Journal of Decorative Art; various publications.
 The Fine Art Society, London—Reproductions in mezzotint, etchings, and pictures.
 W. & A. K. Johnston, Edinburgh—School maps, &c.
 London Colour Printing Co., London—Specimens of colour printing.
 Henry Sell, London—Collection of newspapers.
 C. Smith and Son, London—Maps and globes.
 Arthur Tooth and Sons, London—Artist proofs engravings and etchings.
 Waterlow and Sons, Limited—Printing from steel and copper plates.
 Joseph Zaehnsdorf, London—Bookbinding.
 Raphael Tuck and Sons, London—Illustrated books, colour printing, Christmas and other holiday cards, studies of paintings, and art novelties.
 Engineering, Limited, London—Fifty-four volumes of *Engineering*; framed engravings.
 The Earl of Rosse, Parsonstown—Engravings.
 J. S. Virtue and Co., Limited, London—Photogravures in the *Art Journal*.
 Ruddiman Johnston and Co., Limited—School maps and illustrations.
 George E. Over, Rugby—Collection of books printed by the Rugby press.

Group 151.—Instruments of precision, Experiment, Research, and Photography. Photographs.

- Society for Promotion of Employment of Women
 London—Engravings.

Henry D. Wilkinson, London—Instruments to indicate action of engine valves.

Riley Bros, Bradford—Optical lanterns and slides.

Ross and Co., London—Photographic lenses, field glasses, cameras, lenses, and microscopes.

F. Darton and Co., London—Microscopes and marine glasses; meteorological instruments.

J. Lafayette, Dublin—Photographs printed in carbon.

H. S. Mendelssohn, London—Portraits.

Sheffield High School, Sheffield—Photographs and Educational exhibits.

Mrs. Ayrton, London—Line divider.

Miss A. Gregory, London—Geodoscope.

A. P. Baker, Manchester—Photographs.

W. J. Byrne, Richmond—Photographic portraits.

J. Dore, Sandown—Photographic lantern transparencies.

Esmail Enamel Co., London—Miniatures on enamel.

Henry Flather, London—Carbon photographs.

Bedford Lemere and Co., London—Architectural photographs.

Lyddell Sawyer, Newcastle-on-Tyne—Photographs.

Symonds and Co., Portsmouth—Photographs of British ships.

Henry Van der Weyde, London—Electric light photographs.

W. M. Warneuke, Glasgow—Photographs.

Alfred Werner and Son, Dublin—Photographic portraits.

Window and Grove, London—Photographs.

W. W. Winter, Derby—Photographic studies.

York and Son, London—Photographic lantern slide.

W. Watson and Sons, London—Astronomical instruments, barometers, thermometers, lanterns, photographic apparatus, lenses, &c.

W. Clement Williams, Halifax—Photographs.

R. and J. Beck, London—Photographic apparatus, microscopes.

Royal Astronomical Society, London—Photographs.

W. Lawrence, Dublin—Photographs.

Bourne and Shepherd, Calcutta, India—Photographs, carbon enlargements.

Burroughs, Wellcome and Co., London—Photographic tabloids.

Frederick Downer, Watford—Photographs.

Cameron and Smith, London—Photographs of Lord Tennyson and friends.

Captain W. de W. Abney, London—Photograph, Hoar Frost in the Valley behind the Lower Glacier Grindelwald.

Lyddell Sawyer, Newcastle-on-Tyne—Photograph, Lighten our darkness, O Lord.

G. West, Southsea—Photograph, Yacht Racing, *Mohawk*.

B. Gay Wilkinson, London—Photograph, Sand Dunes.

F. M. Sutcliffe, Whitby—Photograph, Water Rats.

Lieut.-Col. Gale, London—Photograph, Flatford-bridge.

W. England, London—Photograph, View at Chamonix.

F. Hollyer, London—Photograph, Dante's Dream.

H. P. Robinson, Tunbridge Wells—Photograph, The Rising Lark.

Gambier Bolton, London—Photograph, Young Bloodhounds.

A. A. Common, Ealing, London—Parabolic mirror in cell, for silver-on-glass, Newtonian telescope.

Group 152.—Civil Engineering—Public Works, Constructive Architecture.

Robert W. Edis, London—Victoria House.

Joseph F. Ebner, London—System of attaching parquet flooring to a concrete foundation.

Arthur Culpin, Worcester—Reversible and removable window sashes.

British Government, Geological Survey of the United Kingdom, London—Index maps, and memoirs illustrating maps; maps.

British Government, Ordnance Survey of Great Britain and Ireland, London—Ordnance survey of Great Britain and Ireland.

Group 153.—Government and Law.

Waterlow and Sons, Limited, London—Stamps and Bank Notes.

The British North Borneo Co., London—Stamps.

Thomas H. Hinton, London—Postage stamps, cards and envelopes.

Stanley Gibbons, Limited, London—Stamps, stamp albums, &c.

Perkins, Bacon and Co., Limited, London—Stamps Secretary of Department for neglected children and reformatory schools, Victoria—Reports.

Group 154.—Commerce, Trade, and Banking.

Perkins, Bacon and Co., Limited, London—Specimens of bank notes.

Drew and Cadman, London—Window fittings, counters, &c.

Group 155.—Institutions and Organisations for the Increase and Diffusion of Knowledge.

Women of Ireland—Hand-spun, hand-knit woollen goods.

Working Ladies' Guild, London—Collection of poker work in inlaid cabinets.

Ladies' Work Society, London—Fine needlework.

Miss Helen Blackburn, London—Pictures of famous English women.

Royal Society of Art Needlework, London—Collective exhibit.

Scottish Home Industries Association, London—Collective exhibit of Scottish industries.

Royal Microscopical Society, London—Photo-micrographs.

Royal Geographical Society, London—Selections of the Society's publications.

Hakluyt Society, London—Publications of the Society.

Palestine Exploration Fund, London—Maps and publications.

Miss E. E. Murray, London—Designs for china tea services.

Group 156.—Social, Industrial, and Co-operative Associations.

Metropolitan Gardens Association, London—Map showing work done by the Association.
 Women of Shetland, Kinordy Kirriemuir, N.B.—Specimens of knitting.
 Women of Harris, North Harris, Scotland—Specimens of Harris tweeds.
 Mrs. Morrison Duncan, Norton, Scotland—Specimens of ancient fancy work.
 Misses Gillan—Fancy work.
 Mrs. Rogers, Sevenoaks, Ireland—Design in Lime-
 rick lace.
 Soho Club for Working Girls, London—Specimens of work.
 Italian Protestant Orphanage, Florence—Specimens of work.
 Miss Steer, Bridge of Hope, London—Specimens of work.
 Cripples' Nursery, London—Specimens of work.
 Alfred Needlework Association, London—Specimens of work.
 Mrs. Ponsonby, Garry Hill, Ireland—Drawn work.
 Miss Stewart, Ballyardle Co., Down—Specimens of work.
 Indigent Blind Visiting Society, London—Specimens of work.
 St. Chads' Home for Waifs and Strays, Leeds—Specimens of work.
 Mrs. Bernard's Providence Technical Woollen Manu-
 factory, Foxford, Co. Mayo—Specimens of cloth.
 Digby Institute, Bournemouth—Specimens of work.
 Peasant Knitting Industry, Carna—Specimens of work.
 Association for the Encouragement and Improve-
 ment of Hand-made Pillow Lace in the Counties of Northampton, Buckingham, and Bedford—Specimens of lace.
 Chinese Bible Mission to Women and Children, England—Specimens of work.
 Halstead Industrial Home, England—Specimens of work.
 Cripples' Home and Industrial School for Girls, London—Specimens of work.
 The Baroness Burdett-Coutts, London—Classified reports on philanthropic works.
 Industrial Home for Girls, London—Specimens of work.
 Miss Fergusson, West Linton—Specimens of work.
 Ragged School Union, England—Specimens of work.
 St. John's Industry, Parsonstown—Specimens of work.
 Mrs. Vesey Dunleckney, Ireland—Oriental embroidery.
 Convent of Good Shepherd, Limerick—Tambour lace Alb.
 Mrs. Vere O'Brien's Industry, Limerick—Tambour and run laces.
 Royal School of Art Embroidery, Limerick—Embroidered vestments.

Mrs. Bagwell, Marsfield, Ireland—Embroidered articles.
 Clones Lace-making District, Ireland—Crochet work.
 Peasant Woman, Connemara—Specimens of work.
 Convent of Mercy, Kinsale—Specimens of work.
 Convent of Mercy, Newry—Specimens of work.
 Innishmaccsaint Lace Industry, Ireland—Specimens of work.
 Carmelite Convent, New Ross—Specimens of work.
 Golden Bridge Convent Industry, Dublin—Specimens of work.
 Lace-making School, Limerick—Specimens of work.
 Turbotstown Cottage Industry, Turbotstown—Specimens of work.
 Irish Distressed Ladies' Fund, Ireland—Specimens of work.
 Presentation Convent, Youghall—Specimens of work.
 Cappoquin Industry, Cappoquin—Specimens of work.
 Garry Hill Cottage Industry, Garry Hill—Specimens of work.
 Convent of Poor Clares, Kenmare—Specimens of work.
 Cabra Convent Industry, Dublin—Specimens of work.
 Irish Industries Association (Lady Aberdeen's Irish Village), Dublin—Wood and bog oak carving; baskets; Belleek china ware; underclothing; embroideries; laces; linens; woollens; poplins.
 Miss Fraser Tytler, Milton Bridge, N.B.—Statuette, a mud lark, &c.

Group 157.—Religious Organizations and Systems—Statistics and Publications.

The Religious Tract Society, London—Books, &c.
 The Sunday School Union, London—Sunday-school teachers' text-books, &c.
 Women of Victoria, Victoria—Charitable institutions and reports.

Group 158.—Music and Musical Instruments—The Theatre.

E. Bishop and Sons, London—Insulators for pianos; pianos for artisans.
 M. Goggin, Dublin—Harp and carving.
 James Wheeldon, Stockport—Adjustable music stand.
 Augener and Co., London—Music books and portraits.
 F. Besson and Co., London—Musical instruments and accessories.
 S. and P. Erard, London—Harps.
 Joseph Higham, Manchester—Musical instruments.
 Rudall, Carte, and Co., London—Military and orchestral instruments.

DEPARTMENT M.—ETHNOLOGY.

Henry Day—Antiquities from Ireland.

Cambridge Scientific Co.—Instruments for various measurements.
 John Beddoe—Charts and diagrams illustrating the anthropology of Great Britain and Ireland.
 Walter H. Harris—Collection of war medals.
 Captain W. H. Harris—Collection of antiquities

from ancient graves of Colombia, Peru, and Ecuador.
 Alfred C. Maudslay—Photographs of Central America.
 Lady Charlotte Schreiber—Works on playing cards and games.

LIST OF AWARDS FOR INDIA.

DEPARTMENT A.—AGRICULTURE.

Group 1.—Cereals, Grasses, and Forage Plants.

Thakore Sahib Sir Jaswatsinghji Limri—Sesamum seed mustard seed, and castor seed.

Group 4.—Potatoes, Tubers, and other Root Crops.

Thakore Sahib Sir Jaswatsinghji Limri—Peanuts.

Group 8.—Tea, Coffee, Spices, Hops, and Aromatic and Vegetable Substances.

State of Mysore—Coffee.

Harry and Co., Calcutta—Spices and sauces.

Matelli Co., Dooars—Tea.

Jalpaigorie Co., Dooars—Tea.

Kyel Estate, Darjeeling—Tea.

Good Hope Co., Dooars—Tea.

Gurjung-Jhora Co., Dooars—Tea.

Northern Bengal Co., Dooars—Tea.

Nedeem Co., Dooars—Tea.

Ellenbarrie Estate, Dooars—Tea.

Ting Ling Co., Darjeeling—Tea.

Scottpore Co., Cachar—Tea.

Teesta Valley Co., Darjeeling—Tea.

Soom Co., Darjeeling—Tea.

Singbulli and Murmah Co., Darjeeling—Tea.

Pandam Estate, Darjeeling—Tea.

Oak's Estate, Darjeeling—Tea.

Mim Co., Darjeeling—Tea.

Long View Co., Darjeeling—Tea.

Happy Valley Estate, Darjeeling—Tea.

Gyabaree Co., Darjeeling—Tea.

Darjeeling Co., Darjeeling—Tea.

Western Cachar Co., Cachar—Tea.

Selim Co., Terai—Tea.

Second Falodhi Co., Terai—Tea.

Belgachi Co., Terai—Tea.

Pathemara Estate, Cachar—Tea.

Amgoorie Estate, Assam—Tea.

Bibnath Co., Assam—Tea.

Shakomato Co., Assam—Tea.

Tarrapore Co., Cachar—Tea.

Solabari and Malijan Estate, Assam—Tea.

Pathecherra Estate, Cachar—Tea.

Alyne Estate, Cachar—Tea.

Bengal Co., Cachar—Tea.

Tezpore and Gogra Co., Assam—Tea.

Tambulbaree Estate, Assam—Tea.

East India Co., Cachar—Tea.

Puttareah Co., Cachar—Tea.

Borelli Co., Assam—Tea.

Hathibbarrie Estate, Assam—Tea.

North-Western Cachar Co., Cachar—Tea.

Larsingah Estate, Cachar—Tea.

Bicrampore Estate, Cachar—Tea.

Dooloogram Estate, Cachar—Tea.

Indian Co., Cachar—Tea.

Ohat Estate, Assam—Tea.

Moabund Co., Assam—Tea.

Scottish Assam Co., Assam—Tea.

Medla Estate, Assam—Tea.

Greenwood Co., Assam—Tea.

North Sylhet Co., Sylhet—Tea.

South Sylhet Co., Sylhet—Tea.

Kousaine Co., Kumaon—Tea.

Kewacheira Estate, Sylhet—Tea.

Lydiacherre Estate—Tea.

Group 9.—Animal and Vegetable Fibres.

Thakore Sahib Sir Jaswatsinghji Limri—Cotton.

Inspector-General of Forests, Calcutta—Collective exhibit of textile fibres of India.

Group 12.—Malt Liquors.

Murre Brewery Co., Rawal Pindi—Bottled stout.

Group 17.—Miscellaneous Animal Products—Fertilizers and Fertilizing Compounds.

Comp. Pastoril Industrial Sul. Co., Peletar—Calcined bones.

Group 18.—Fats, Oils, Soaps, Candles, &c.

Inspector-General of Forests, Calcutta—Collection of oil seeds.

Conservator of Forests, Dehra Dun—Collection of oils.

Group 19.—Forestry, Forest Products.

Indian Government, Simla—Forest maps; wood carving, or ornamental wood of Burma; padouk lumber from Andaman Islands

Conservator of Forests, Simla—Assam resins and oils; minor forest products of North-Western Provinces of India; Assam timbers and teak, and satin woods. Bombay—Bombay timbers; oils and resins, raw and manufactured. Madras—Timbers and sandal wood; dye and tanning woods; oil-yielding plants and resins.

Inspector-General of Forests, Simla—Wood carving on ornamental woods.

Bombay Burmah Trading Co., London—Timbers and planks of teak wood.

DEPARTMENT E.—MINES AND MINING.

Group 46.—Graphite and its Products; Clays and other Fictile Materials and their Direct Products; Asbestos, &c.

Nathan Rain, Agra—Marble mosaics.

Khuj Beharilal, Agra—Marble mosaics.

Moolchund Kasiram, Surat—Carved sandalwood; mosaics.

DEPARTMENT G.—TRANSPORTATION.

Group 85.—Vessels, Boats—Marine, Lake, and River Transportation.

S. J. Tellery and Co., Calcutta—Models of various water crafts.

DEPARTMENT H.—MANUFACTURES.

Group 87.—Chemical and Pharmaceutical Products—Druggists' Supplies.

Dr. D. N. Banerjee, Calcutta—Preparations from Indian indigenous herbs.

Group 90.—Furniture of Interiors, Upholstery, and Artistic Decoration.

Ardeshir and Byramji, Bombay—Ivory, ebony, and white metal inlaid in sandalwood table, cabinet and writing desk.

F. P. Bhungara and Co., Madras—Carved teakwood furniture.

Lockwood de Forrest, Ahmedabad—Carved teakwood furniture and teakwood interior.

H.H. the Maharajah Gaekwar of Baroda—Furniture.

Group 91.—Ceramics and Mosaics.

F. P. Bhungara and Co., Madras—Terra-cotta figures.

Group 93.—Art Metal Work—Enamels, &c.

Ardeshir and Byramji, Bombay—Brass engraved and enamelled work; silver inlaid with copper and brass, from Tanjore; Cashmere and Benares copper and brass, hand chased.

F. P. Bhungara and Co., Madras—Silver inlaid in steel; silver inlaid in copper; Jeypore brass, hand carved; Benares brass, hand carved; Cashmere enamelled work; Cashmere carved copper.

Sultan Mahomed, Cashmere—Enamel on silver.

Abdullah Khan, Cashmere—Enamel on copper; copper repoussé engraved.

Mahomed Bux, Cashmere—Enamel on copper; copper repoussé engraved.

Bawal Mistry, Jeypore—Brass repoussé.

Durga Kishur, Poona—Brass repoussé.

Cheta Ram Lakwichuna, Poona—Brass repoussé.

Gopichund, Jeypore—Brass repoussé engraved.

Gulabchund, Jeypore—Brass repoussé engraved.

Burgu Kighan, Benares—Brass repoussé engraved.

Bisseswar Peshad and Sactal Prashad, Benares—Brass repoussé engraved.

Group 96.—Carvings in Various Materials.

Ardeshir and Byramji, Bombay—Tortoise shell and buffalo; boxes set in ivory; Bombay blackwood carving; teakwood; sandalwood; carved furniture of all descriptions; screens, tables, and desks; ivory carvings, bulls' horn ornaments; card trays.

F. P. Bhungara and Co., Madras—Carved ivory sticks; teakwood screen; rosewood table inlaid with pearls; sandalwood boxes, inlaid with ivory.

H.H. The Maharajah of Mysore—Carved sandalwood. H.H. The Maharajah Gaekwar of Baroda—Wood carving.

Framjee Jewanjee, Surat—Carved sandalwood.

Moolchund Kasiram, Surat—Carved sandalwood.

Vencats Swami, Vizagapatam—Sandalwood, ivory and horn decorated ware.

Kundum Dutt, Vizagapatam—Sandalwood, ivory and horn decorated ware.

Abdullah, Nagina—Carved ebony wood.

S. J. Tellery and Co., Delhi—Sundry wood carving.

H.H. Chuckoo Bhud, Baroda, Ahmedabad—Wood carving.

Group 97.—Gold and Silver Ware, Plate, &c.

Ardeshir and Byramji, Bombay—Madras and Cutch silverware, handchased.

F. P. Bhungara and Co., Madras—Chased silverware, vessels of all descriptions.

H.H. the Rao of Cutch—Silver articles.

S. J. Tellery and Co., Delhi—Silver articles.

Varna and Co., Lucknow—Silver articles.

Raojee Mull, Lucknow—Silver articles.

Oomerjee Mowjee, Poona—Silver articles.

Shoer, Marain and Co., Cashmere—Silver articles.

Telb Novandas Naraindass, Bombay—Silver articles.

Sultan Mahomed, Cashmere—

Khasiram, Pandia and Co., Tanjore—Incrusted metal on ware; enamel on brass.

Sroom, Pether, Tanjore—Incrusted metal ware.

H.H. The Nizam of Hyderabad, Hyderabad—Incrusted metal on silver and steel.

Azizuddin, Moradabad—Enamel on brass.

Sohon Lal and Co., Moradabad—Enamel on brass.

Chiranjee Lal Kannah and Co.—Enamel on brass.

H.H. The Maharajah Gaekwar of Baroda—Ivory carvings, and ornaments for the person.

Group 100.—Silk and Silk Fabrics.

Gungaram Kallanchund, Surat—Brocades (kinkobs); manufactured silk.

H.H. the Nizam of Hyderabad—Brocades (kinkobs); manufactured silk.

S. J. Tellery and Co., Delhi—Manufactured silk.

State of Mysore, Mysore—Silk.

Group 102.—Yarns and Woven Goods of Cotton, Linen, and other Vegetable Fibres.

Ardeshir and Byramji, Bombay—Curtains.

F. P. Bhungara and Co., Madras—Hand-painted curtains.

S. J. Tellery and Co., Delhi—Cotton rugs.
 Rahim Khan, Etawah—Cotton rugs.
 Orphanage, Fategurh—Cotton rugs.
 Gannu Mull, Farukhabad—Cotton prints.
 Chelaram Gayanchund, Madras—Cotton prints.
 Choti Lall, Delhi—Cotton prints.
 Shumboonath Rugnathdass, Amritsar — Cotton prints.
 Morarilall and Pearylall, Meerut—Cotton prints.

Group 103.—Woven and Felted Goods of Wool, and Mixtures of Wool.

F. P. Bhumgara and Co., Madras—Carpets and rugs.
 S. J. Tellery and Co., Delhi—Woollen pile carpets.
 H.H. The Nizam of Hyderabad, Hyderabad—Woollen pile carpets.
 H.H. The Maharajah of Mysore, Mysore—Woollen pile carpets; woollen stuffs, plain.
 Shumboonath Rugnathdass, Amritsar—Woollen pile carpets; woollen stuffs, plain.
 Beniprasad, Mirzapore—Woollen pile carpets.
 Harvey and Allen Mitchell, Cashmere—Woollen pile carpets.
 Kirparam Humumal, Lahore—Woollen stuffs, plain.

Group 104.—Clothing and Costumes.

Indian Women's Work—Scarf; Assamese dress; handkerchief; Parsee boy's dress, purple satin; Mohammedan dress, green satin; Mohammedan dress, muslin; bodice; bhourks.

Group 106.—Laces, Embroideries, Trimmings, Artificial Flowers, Fans, &c.

Ardeshir and Byramji, Bombay—Hand-painted wood fans.
 F. P. Bhumgara and Co., Madras—Madras embroidery on plush, satin, and cloth.
 Kirparam Kumumal, Lahore—Embroidered woollen stuffs.
 Shumboonath Rugnathdass, Amritsar—Embroidered woollen stuffs; embroidery on cotton stuffs.
 H.H. The Nizam of Hyderabad — Embroidered woollen stuffs.
 S. J. Tellery and Co., Delhi—Cashmere shawls; embroidery on cotton stuffs; embroideries.
 H.H. The Maharajah of Jodhpore—Embroidery on cotton stuffs.
 H.H. The Maharajah of Kapurthala—Embroidery on cotton stuffs.
 Daday Khan, Meares—Silk embroideries.
 Nagervil Mission, Nagervil—Silver and gold lace.
 Canochi Lall and Son, Agra—Silver and gold embroidery.
 Indian Women's Work—Yellow silk embroidered square; Indian silk embroidered specimens; Benares silver embroidered scarf.

Group 120.—Plumbing and Sanitary Materials.

H.H. The Maharajah of Mysore—Wood inlaid with ivory.

Mayadas, Moshcarpur—Wood inlaid with ivory.
 H.H. The Maharajah of Patiala—Wood inlaid with ivory.
 S. J. Tellery and Co., Delhi—Wood inlaid with brass.

Group 121.—Miscellaneous Articles of Manufacture not heretofore classed.

Ardeshir and Byramji, Bombay—Brass wire inlaid in rosewood.
 Dass and Co., Calcutta—Brass lock.
 Indian Women's Work, Nampur—Infant's quilt.

DEPARTMENT L.—LIBERAL ARTS.

Group 151.—Instruments of precision, Experiment, Research, and Photography. Photographs.
 Bourne and Shepherd, Calcutta, India—Photographs, carbon enlargements.

Group 152.—Civil Engineering—Public Works, Constructive Architecture.

Lalu Deen Dayal, Secunderabad—Photographs of carving and architecture.
 H.H. The Maharajah Gaekwar of Baroda—Architecture and decoration.

Group 155.—Institutions and Organizations for the Increase and Diffusion of Knowledge.

Ravi Varmah, Trivandrum, Travancore—Paintings in oil.

Group 157.—Religious Organizations and Systems—Statistics and Publications.

H.H. The Maharajah Gaekwar of Baroda—Figures and carved representations of Hindoo Deities.

DEPARTMENT M.—ETHNOLOGY.

H. C. Thompson—Buddhistic sculptures from India.
 H.H. The Maharajah Gaekwar of Baroda—Portfolio of architectural details; ethnological objects from Baroda.
 Pranjewundas Lalubhai and Harkisundas and Co.—Embroideries executed by Goldsmith Caste of India.
 Lala Deen Dayal (Secunderabad Deccan)—Photographs of archaeological remains (India).
 Chakubhai Bhuderdas—Carving on wood.
 Lala Sunde Lal—Indian manuscripts.
 P. Vencatachellum—Alimentary products (native).
 Hormusji Muncherji—Indian condiments.
 Framjee Nowrojee—Alimentary products used by the people of India.
 Damoder Ratansey—Alimentary products (native).
 Sormath Bhuderdas—Carving in wood and ivory.
 Thakore Saheb of Limri — Alimentary products (native).
 Bodraj and Co.—Hog spears.
 S. J. Tellery and Co.—Antique Indian coins.

LONDON:

PRINTED BY WILLIAM TROUNCE, 10, GOUGH SQUARE, FLEET STREET, E.C.

Journal of the Society of Arts.

No. 2,162. VOL. XLII.

FRIDAY, APRIL 27, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday, April 10, 1894; SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., in the chair.

The paper read was—

EVOLUTION IN DECORATIVE ART.

BY HENRY BALFOUR, M.A.

It is my object this evening to describe in a brief and general way some of the changes undergone by art designs in their treatment, especially for decorative effect, and the causes which have brought about these changes, as illustrating the very many influences which affect the developmental history of patterns and designs generally. I shall also give a few instances in which the actual origin of certain ornamental designs can be ascertained and accounted for.

As, in the course of a single paper, I can only hope to treat of my subject in a very general and cursory manner, it is necessary that the examples selected should be as simple as possible, and with this object in view I have chosen illustrations for the most part from the art of the less cultured races of mankind; as, the lower we go in the scale of civilisation, the fewer agencies do we find affecting the growth of any particular art or industry, and, consequently, there is a diminished complexity with which to deal.

Before passing on to the main subject of my paper, a few words regarding the early history of the art of design may not be amiss. It is when we endeavour to form conclusions as to the probable origin and early developmental stages of art that we are brought face to face with the consideration of the relationship of Anthropology to Archæology. These sciences are very closely allied, indeed, the

two studies can hardly exist apart from one another, as each serves at times to elucidate points which are obscure in the evidence at the disposal of the other. The dominant idea in the two sciences is the same, to trace a continuity in the history of the human race, and to endeavour to form an unbroken chain of evidence to show the successive changes whereby man has arrived at his present state, both physical and mental. Anthropology, as dealing principally with the recent races of mankind, offers to archæology facts culled from peoples in various conditions of culture and physical development, peoples which variously exhibit, we believe, conditions of progress, arrested or retarded at different stages in the general progressive evolution. The present is offered in explanation of the past, the living as representative of the dead. In the study of the history and gradual development of the art of design, more particularly in its earlier stages of growth, we feel very specially the need of something beyond the evidence supplied by archæology. This in no way gives an unbroken continuity, and of man's earliest efforts in plastic and graphic art, we have no actual trace remaining. The earliest period at which we meet with relics of man's attempts in this direction, belongs, it is true, to a relatively very remote age, when the mammoth and reindeer were conspicuous features in Central France, and the climate there was of that rigorous kind which suited these representatives of an arctic fauna. Remote as was this so called "Cave Period," we find from the associated relics of man's handiwork, that human culture had in many ways already reached a considerable degree of development; that man already displayed not only ingenuity and dexterity in the manufacture of the implements of his every day life, but also a skill and taste of no mean order in the art of design, as evidenced by his application of decoration to his implements. The often extremely clear and realistic sketches of the more characteristic animals, engraved upon pieces of horn, bone or ivory, or carved in complete relief as ornamental handles for horn daggers, show not only a keen observation and accurate knowledge of the animals portrayed, but also a considerable experience and adroitness in the use of the burin and the carving tool of the period, even though these were but flakes of flint and such rude appliances. It is quite evident that the beginnings of art are not to be found here. In the still earlier period of the river drift gravels, we find

no traces of art work amongst the remains of human industry preserved, and we are therefore unable, from actual relics of antiquity, to trace the history of this branch of æsthetic industry back beyond a period at which it had already reached a high state of development, which implies a long ancestry in the remoter past, of which we, as yet, know nothing.

In view of the lack of any archæological evidence as to the origin and early development of the art of design, if we turn to the study of the *living* races of man, we find that we may gather much that is suggestive and capable of throwing light upon the obscurity, and we are able to form some conclusions as to the probable succession of progressive changes undergone by art in the days of its infancy. In the life of the lowest or least cultured modern savage races, we see reflected to a great extent the condition of primeval man, as has been ably pointed out by General Pitt Rivers,* and a study of the condition of art among modern primitive folk cannot fail to illumine the obscure points in its actual early history in prehistoric times.

In examining the handiwork of these people, it becomes evident that their ideas are very largely derived from nature's suggestions. The forms of their implements are, for the most part, natural shapes, but slightly improved upon or adapted. We see, also, how readily curious or unusual natural objects are appreciated and valued, and made to serve usually as charms, as being endowed with magic properties. In accordance with the "animistic" ideas of primitive man, those objects in nature which bear an accidental resemblance to some familiar thing—say an animal or the human form—are especially valued, as having a kind of physical sympathetic relationship with the object whose form they simulate. One may readily believe that the rudiments of the art of æsthetic design are to be traced to the appreciation of the unusual in nature, associated largely with the primitive beliefs in the magical properties of such 'peculiarities'. Strange shapes were eagerly sought for, and carefully preserved, and valued according to the degree to which they were uncommon, or the extent to which they showed resemblances to familiar objects. In the Pitt Rivers collection at Oxford is an Australian boomerang of yellow wood, cut out in such a manner as to

exhibit along the central line a row of very dark natural knots in the grain, which occur at fairly regular intervals, and form an effective, though purely natural decoration. Until recently natural boulders of peculiar shapes, especially if in any way suggesting the human form, were objects of worship to the Lapps. Of the many charms, whose virtue lies in their resemblance to certain objects, I may mention the two-hooked martynia seed capsules, whose resemblance to the head and fangs of a poisonous snake has caused them to be used as charms against snake bites. In much the same way, the kernel of a kind of chestnut—native of Demerara—(*Ophiocaryon serpentinum*), which resembles very curiously a little coiled up snake (Fig. 1), was assumed by the early colonists to be effective as an antidote to snake poison.

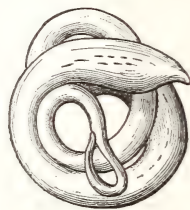


FIG. 1.

This merely "appreciative" stage can only be regarded as introductory to the origin of art, the actual germs of which appeared in the next stage. This new stage was arrived at when first the natural peculiarities or resemblances were slightly intensified, by the application of artificial means to increase them. Where, for instance, an accidental resemblance to an animal's head was seen, it would have been seen that the addition of a spot at the right place to represent an eye would greatly increase the resemblance; or, by blackening the nodes on a reed stem, the decorative effect, already suggested by the regularity with which these are naturally disposed, would have been heightened. The first application of such slight improvements would not have required a great mental effort, and would have formed a perfectly natural sequel to the appreciation of the purely natural effects. As belonging to this "adaptive" stage, I may cite, as examples from modern life, the gnarled roots which the Chinese value for the weird resemblances which they sometimes bear to animals, and which the people touch up here and there in order to make the resemblance stronger, thereby producing very grotesque monsters.

* "Primitive Warfare." *Journ. Roy. United Service Inst.*, xi. No. 47.

The mandrake roots sold in the Asia Minor bazaars as charms, by virtue of their resemblances to the human form, are, in reality, for the most part partly carved with a knife to enhance their value in the eyes of the ignorant buyers, who believe that they are of purely natural growth. I have a sealing charm which was carried by a Haida Indian, of Queen Charlotte Island, when seal hunting; this is merely a natural pebble of elongate shape, somewhat resembling a seal in outline (Fig. 2). The hunter, in order to increase the resemblance, and, consequently, the value of his charm, added a circle, with a dot in the centre to represent the eye, on each side, and scratches to indicate the mouth.*



FIG. 2.

In the earliest days, no doubt, the additional artificial touches were but few, and the natural effects but slightly increased, but, as time went on, the increasing use of artificial means, to improve upon natural peculiarities, doubtless led gradually to a stage in which the whole effects were produced artificially, and it was found that the effects could be thus copied. This brought the development of art to a definite "creative" stage, and, once man found that he could produce at will decorative effects or representations of objects, the real starting point of art industry was reached, and

* This and some of the other illustrations in this paper have been already published by me in a book upon "The Evolution of Decorative Art," upon the lines of which this paper is written.

a very wide field for the development of his æsthetic tendencies and imitative faculties was opened out. The magic powers of nature's accidental portraits were transferred to the afterfact representations, though the peculiar natural forms were, and are, none the less eagerly sought for and valued as the more potent of the two kinds. At first, no doubt, it was nature's decorative patterns which were copied, before man more and more emancipated himself from his "mistress in art," and proceeded upon somewhat more original plans of his own. The three stages, *appreciative*, *adaptive*, and *creative*, seem to follow one another in a perfectly natural sequence, and there can be little doubt that these represent the successive epochs in the early history of art; and our knowledge of modern savage life does, I think, fully bear out the probability of such a sequence, and help to establish this in relation to primeval man in his early crude efforts in the production of objects of art.

So far as representations of objects, or portraiture is concerned, it would seem likely that graphic art was derived as a later development

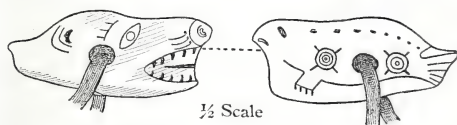


FIG. 3.

from plastic art, though this is largely a matter of conjecture. We know that solid shapes appeal more readily to the lowly cultured mind, than do designs representing the same objects in the flat, and we can readily imagine a gradual evolution of graphic representation from the application of lines and fine incisions to express important details which were lacking in the solid representations of objects. The freer use of lines as a means of expression would in time have led to the discovery that the entire object could be represented in this way upon a flat surface, and with less labour than was required for carving or moulding figures in complete relief. In illustration, I will take a case from the art of the Eskimo, though this in no way pretends to be actually a *primitive* transitional example, as the art of these people, both graphic and plastic, is highly developed. The little ivory toggle is carved into a shape representing the head of a polar bear (Fig. 3), the details not expressed by the shape being added by means of supplemental lines, thus the mouth, eyes, ears, &c., are supplied. On the reverse side we see that

the bear's head has given place to a representation of a seal; but the shape of the piece is not so well adapted to express the outline of a seal, and we see that the supplemental lines have to convey more in this case than in the other, the lower part of the body and the limbs are drawn in, as they are not otherwise suggested.

How far the application of colours to flat surfaces influenced the early development of graphic art, as applied to outline representations of objects, it would be hard to say. We know that the use of colours in painting for decorative purposes was of great antiquity, and no doubt the habit of giving patches of colour definite shapes had some effect in assisting the growth of outline drawing, but into this I cannot now enter.

The few remarks which I have been able to make upon the general subject of the early history of plastic and graphic art, from a general standpoint, must necessarily convey very inadequately the points upon which I have touched. In dealing with so wide a subject, it is unavoidable that one's remarks should appear sketchy, and possibly unconvincing, but I am anxious to-night to give some account of the origin of individual patterns and art forms, and to put before you some of the factors which create changes in designs, and cause these to be unstable and ever changing.

If I were to say that *copying* is one of the chief agents in creating variations in designs, I might be accused in dealing in paradoxes, but I should be quite justified in making the statement, and, as a matter of fact, I do make it. Man is nothing if not imitative, and the art of copying is perhaps one of his most useful accomplishments. But, even where every effort is made to produce an accurate copy of an original, in no case is the result an exact *facsimile* of the object copied. In estimating the value of copying, one must not undervalue the individuality of the artist. No two will copy an object in precisely the same manner, and with the same result; there is always the personal element to be reckoned with. In some cases this is very marked. Sir Robert Porter bitterly complains, in his "Travels in Georgia," of the inaccuracy with which sculptures were copied by archæologists; and he gives in his book a plate showing copies of the same bas-relief by three different explorers. The results are so absurdly different, that it becomes a compliment to Sir Robert Porter, when we take his word for it that they

are really intended to represent the same sculpture. It is certain that, if the ancient Persepolitan sculptor were to see them, and were able to recognise one of the designs as a copy of his own bas-relief, he would utterly refuse to hold the same view with regard to the other two copies.* This is, perhaps, an extreme case, but it is useful as illustrating the effect of the individual eye and hand in copying.

Suppose, however, instead of all being taken directly from an original, the copies are made *successively* one from another, the last copy of the growing series being in each case the model for the next. The changes produced by this process of successive copying



FIG. 4.

are often very astonishing, and it would be difficult to overestimate the importance of this process as an agent in producing variations in designs. This anyone can try for himself; it is only necessary to give some design to be copied by a person whom I will call A, give A's copy to B to reproduce, B's to C, and so on, and it will be seen that while each may be a fairly good representation of the one before, as the series grows, a marked difference between the original design and the last of the successive copies has arisen. The number of copyings required before any marked change

* The copies shown in the plate are by Chardin in 1674, Le Brun in 1704, and Neibuhr in 1765.

is noticeable will, of course, depend upon the degree of skill of the copyists. A sketch representing a snail crawling over a twig, which I gave out to, for the most part, fairly unskilled hands to copy, successively went through a series of rapid changes, and became, in the course of some fourteen copyings, a kind of bird-like figure. The shell of the snail gradually left its owner, and crawled up the twig; the end of the twig became the head of the bird, the growth rings becoming the eye; the eye stalks on the head of the

snail were metamorphosed into the forked tail of the bird. After the twelfth copy the design was copied upside down, as it looked more realistic so, and thus the bird came into being. Though the copies are not good ones, there is no striking difference between any two adjacent ones, but, nevertheless, there is no resemblance whatever between the first and the fourteenth, and, if seen apart from the series, no one would suppose them to be related. (Fig. 4, p. 458.)

In a similar manner, a sketch of a Greek



FIG. 5, A.—JOHN WHITE'S DRAWING.

warrior became gradually, after nine or ten copyings, one representing a female figure, the collar-bones of the warrior having drooped more and more into a V-shape, till they became the edges of a cloak thrown loosely over the woman's shoulders, the warrior's muscles becoming folds in the cloak.

It may be urged that in skilful hands very little change would be noticeable, but I will give an illustration to show that even when skilled engravers have been the reproducers of a design, remarkable changes are apt to

occur when the design is copied *successively*. The series which I give is one of four only, an original and three copies. The designs represent a ceremonial dance of the natives of Virginia in the 16th century (Fig. 5 A). In the three copies I have only given a portion of the plate, showing a few figures only. The first is from a photograph of the original water-colour drawing by John White, dating towards the end of the 16th century. The second from an engraving in De Bry's edition of Harriot's "Description of Virginia" (second or third edition, 1634),

this having been taken from White's drawing and reversed. The third from Lafitau ("Moeurs des Sauvages," II. pl. 6, 1724), copied from De Bry's plate and reversed back

again. The fourth from an engraving in Sir John Lubbock's "Origin of Civilisation" (p. 248, 1875), copied from Lafitau. Now let us look at the figure in the centre of the

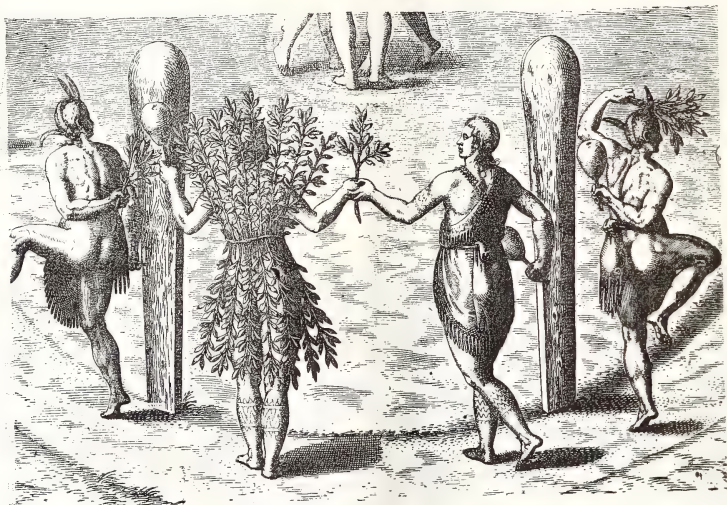


FIG. 5, B.—DE BRY'S COPY OF WHITE'S DRAWING.

original drawing, slightly turned towards the right. A gourd rattle is held in the left hand, for shaking as an accompaniment to the

dance. This we see plainly in De Bry's reversed, but excellent, not to say idealised, engraving. In Lafitau's engraving the gourd

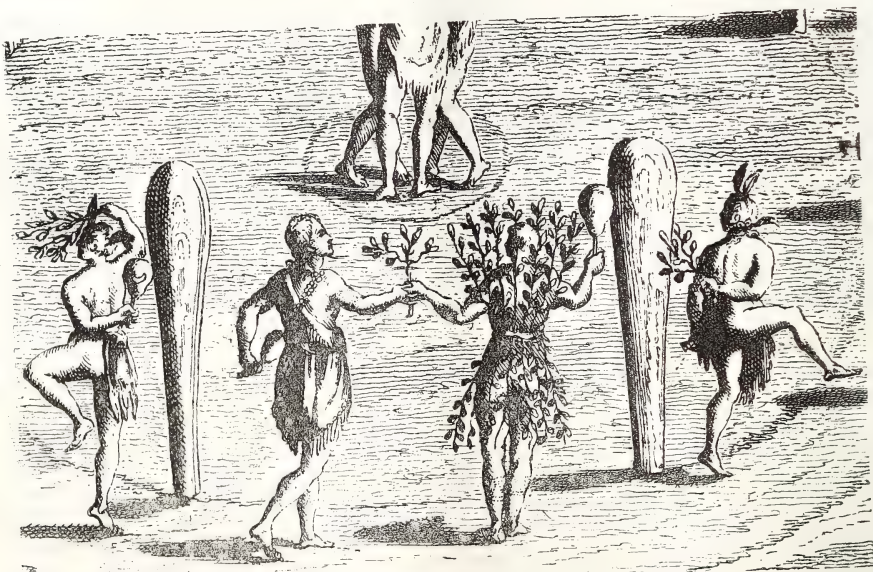


FIG. 5, C.—LAFITAU'S COPY OF DE BRY'S ENGRAVING.

is still there, but badly represented, very darkly shaded on one side, with but a faint line to represent the outline of the gourd on the other side. This faint line escaped the

notice of Lubbock's engraver, and he represented the figure as clutching the shading only, literally "grasping a shadow," most unsatisfactory for the dancer! The figure

dressed in leafy boughs in the original holds a small branch in his right hand, this appears as a gourd rattle in the copies; perhaps this compensates somewhat for the loss of the other dancer's rattle. Such changes as these are, I suppose, considered permissible under the plea of "engraver's license," but when the letterpress, too, becomes bitten with the same craving for change, and endeavours to follow and keep pace with the erratic metamorphoses of the illustrations, it is, perhaps, going a little too far. The upright columns, which in the entire design can be seen standing in a circle, are described in Harriot's original work as "posts," and in De Bry's Latin translation as "tigna." They are clearly of wood, and are so represented in De Bry's engraving, where very evident knots

in the grain are seen; these are hardly shown in Lafitau, and his careless representation has led to the materials of the posts being changed in the later description. Sir John Lubbock writes—in his reference to the illustration—as follows:—"It is very interesting to see here a circle of upright stones, which, except that they are rudely carved at the upper end in the form of a head, exactly resemble our so-called Druidical temples!" I would draw special attention to the fact that all the changes mentioned in this case have occurred in the course of three successive copyings only. One shudders to contemplate what would have occurred in fourteen or twenty. These examples will suffice to show how very great may be the changes wrought unintentionally through the agency of successive copying,

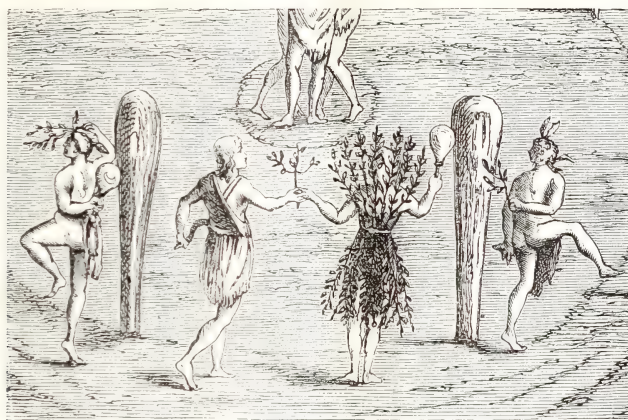


FIG. 5, D.—COPY OF LAFITAU'S ENGRAVING FROM LUBBOCK'S "ORIGIN OF CIVILISATION." *

and how very necessary it is, where possible, to go direct to the original source, whether for illustrations or descriptions. The rate at which change will take place varies necessarily with the skill and care exercised by the artists, and the relative difficulty of the material, and other details of circumstances, but, whether the copyists be inexperienced and unskilled, or whether they be the leading artists of the day, the changes would still be seen, though in the one case a longer series would be required to effect any radical change in the design, the difference between any two adjacent copies being far slighter in the case of skilled artist's work. Where designs have been reproduced from *memory* we can readily understand that still more marked variations from the original will occur. Such changes as

are produced unintentionally through carelessness and the impossibility of copying quite accurately, are due to what I have called *unconscious variation*. But, active as is this process as a factor in producing change, it is usually accompanied, and the change is accelerated, by the still more active and unrestrained agent *conscious variation*. In the reproduction of ornamental patterns there is often, usually in fact, a desire to vary, or to improve upon, the design copied. The motives for this intentional variation are many and various, and, while sometimes the changes are merely to suit the individual taste, or are due to caprice on the part of the artist, at other times they are of a more strictly utilitarian nature.

I now propose to give some instances of the

* This illustration is kindly lent by Messrs. Longmans.

development of certain ornamental designs, with a view to illustrating some of the many causes which either dictate the primary form of the design, or which affect its after developmental history, and regulate the changes undergone by it. I will first take as my examples designs whose primary motive is a representation of human or animal forms, and I include for sake of brevity, both would be realistic and grotesque treatments of these themes. I begin with a case from savage life, in which we may see successive changes apparently due to the individual tastes of the artists, though it is probable that there may have been the very usual utilitarian value for the variations as *marks of ownership*, as, where the objects, spears in this case, were very similar, they could be individually recognised by their ornament. The patterns which I show are carved upon the shafts of spears from the Solomon Islands, always at about the same place.

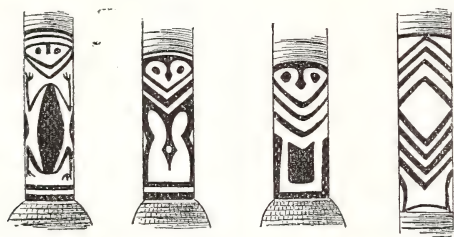


FIG. 6.

In the first we can recognise a little grotesque human figure with very large angular mouth. In the second we see that, while the body and limbs are vanishing away, this prominent mouth is reduplicated. The third shows three chevron-like mouths and but scanty remains of body and limbs. In the last example the "mouths" have completely gained the day, and form a series of chevrons, with a corresponding number turned the other way for symmetry. A few lines only at the base represent the last struggling remnants of the lower parts of the body. Although I do not pretend that these patterns are strictly consecutive, there can be little doubt that they are closely related and that the order of their appearance has been as described, the more realistic preceding the more conventional.

In the same group of islands one may see designs representing the frigate bird in all stages between very fair realism and complete conventionalism. The stages which are midway between the realistic and the fanciful are interesting, as, while the prototype of the de-

sign may still be recognised, one may at the same time see to some extent the direction whither it is tending in its passage towards a purely meaningless pattern, whose resemblance to a natural object has entirely ceased (Fig. 7).

I give an example from West Africa of two little carved wooden human fetish figures with long horns, the one showing body and limbs complete, the left hand holding the bowl of a pipe which is being smoked, and the other figure showing the same design in a more conventional form, the body and limbs fused into a mass below and the pipe hanging centrally between the mouth, or rather chin, and this body mass (Fig. 8).

The human form in its treatment for decorative purposes undergoes marvellous vicissitudes, and affords, perhaps, the most striking instances of the effect of successive copying

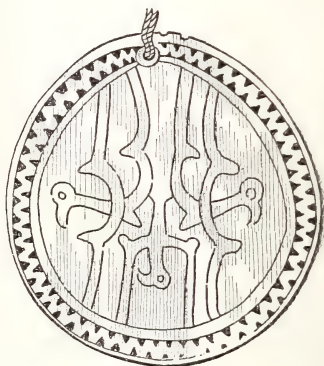


FIG. 7.

when the object is to create slight variations, often in order to produce a greater ornamental effect. When we look at the marvellously intricate scrolled patterns, carved with great skill by the Maories of New Zealand, we can see that there is a general relationship in their character; and if we take a sufficient number of examples, and classify them carefully, so as to form more or less consecutive series, we can see that in nearly all cases the pattern of the scroll work, however intricate and fanciful, is referable to one primary theme—a representation of the human form. Sometimes it is the face only, the beautifully tattooed lines of which readily lend themselves for transference as ornamental effects to materials such as woodwork; in other cases, the body and limbs have also been brought into the design, and may still be recognised in the less fanciful examples. In the very conventionalised examples the nature of the primary conception can only be interpreted by an examination of

other allied designs which have retained something of the original form.

Often enough, instead of an amplification of a design, or the retention of its more decorative elements, we see a process of degradation in the history of a design. The parts gradually drop out—it may be through careless

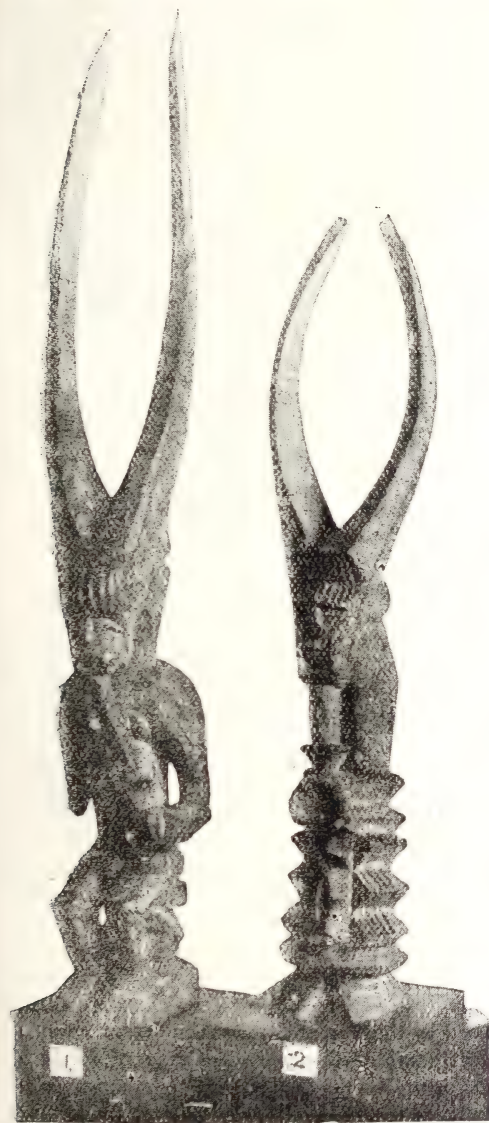


FIG. 8.

representation, or it may be through accident—and disappear one by one till there is no trace left. One notices the effects of degradation-processes in the well-known “face vases” of Mykenae, in which the last remnants of what once represented a female head and bust, are two little dabs representing the

breasts, with no context to explain their origin, which can only be discovered by examining a number of examples of earlier date.

In the case of some ornamental designs, there is a definite reason for creating variations. The case of the Japanese family crests, for example, supplies us with excellent instances of necessary variation from the original form of the crest, as new branches have arisen of the family, each demanding a fresh variation upon the emblem of the original family stem. The new design must be closely allied to the original, but must be sufficiently distinctive to denote a particular family branch. The crane, which, as emblem of longevity, appears in realistic form so frequently in Japanese art, is the original subject of one series of family crests, and becomes by successive modifications a kind of floral

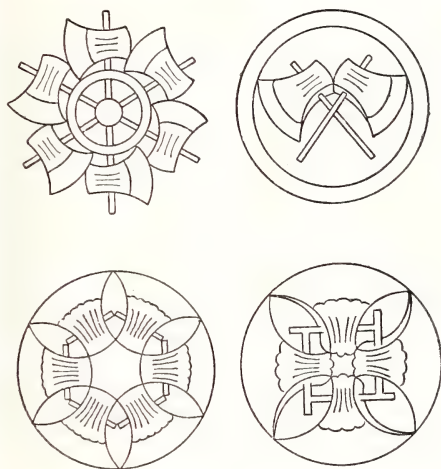


FIG. 9.

calix upon a stem. The axe is another totem, so to speak, and in some of the variations upon this theme we see a number of axes arranged around a centre, and forming a kind of rosette; the handles, in some cases, nearly or quite disappear, and it is difficult to recognise an axe form at all in the later modifications (Fig. 9). So, too, we may see floral designs derived from butterflies, and so on in endless variety.

The tendency for the *more important portion* of a symbolic design to persist, while the rest may disappear, has its curious illustrative instances, of which I give one. A common design in Maori art is one representing a face, with a tongue enormously protruded. This protruded tongue is symbolic, and is intended to convey the expression of defiance to an enemy. Hence, the tongue is the most

important feature represented, and it is essential that this should remain intact, though it matters less what becomes of the other features of the face. This minor importance of the rest of the face is exemplified in the three figures representing this design upon the tops of Maori ceremonial staves. In the first, a grotesque full face is seen, with the tongue of huge size, and duly protruded. The second is seen to have the face in profile, though the tongue remains full face, this showing how

little the eyes and nose and mouth are concerned in the symbolism of the design. The third example shows the complete suppression of face, while the tongue remains unchanged, and conveys its meaning just as well as ever to one who knows the origin of the design. So it is with other symbolic designs, which, although they have a definite and important meaning to convey, are liable to extensive variation; but, while the parts of lesser importance may disappear early, the more strictly

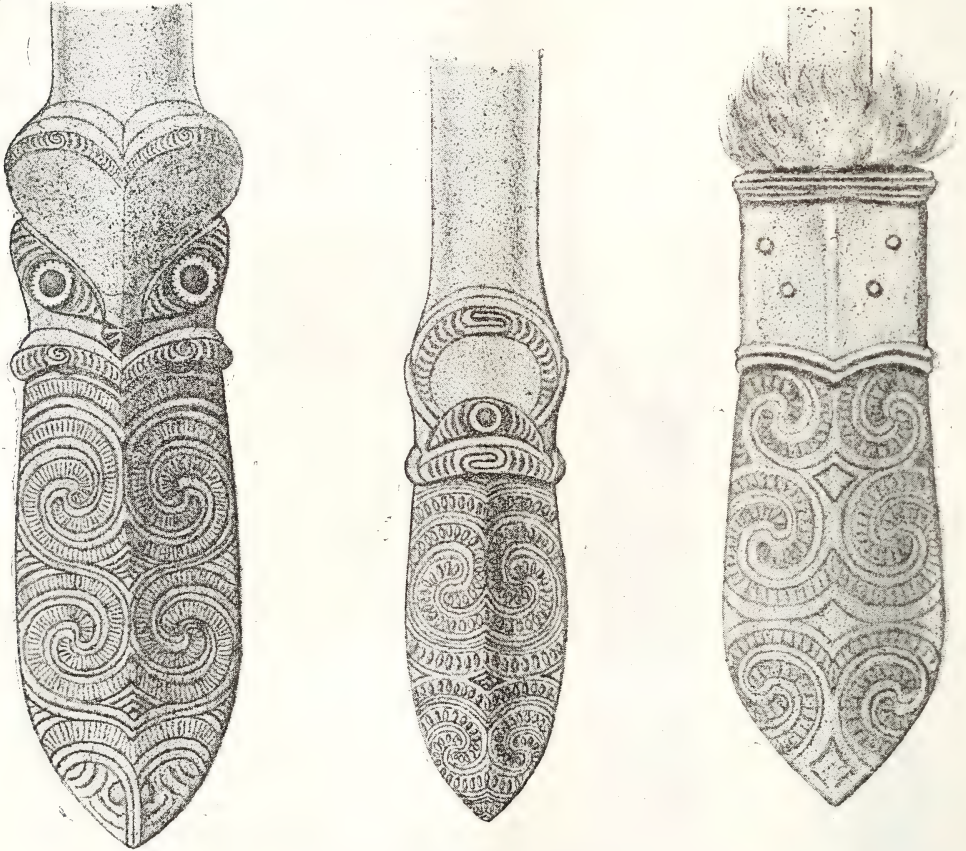


FIG. 10.—From Joest's "Tatowiren."

symbolic portions are usually the last to become modified, and these tend to persist, in spite of the disappearance of their context.

A constantly occurring cause of variation is the influence of one design over another. It is a matter of difficulty to discern the extent to which this takes place, but in some cases it is very obvious, especially so where two or more designs of different nature are subject to constant repetition in close proximity. Thus Haddon,* in describing the very elaborate dancing masks of tortoiseshell, made and

used by the Torres Straits islanders, mentions that some of these are in the form of crocodiles, while others represent the shark. The influence of this latter design over the former seems to appear in the presence of lines representing gills upon the crocodile figures. Now gills are in no way legitimate attributes of crocodiles, and one must suppose them to have been borrowed from the shark designs, in which they have a true morphological value. I must be content with giving this single instance of a very common factor in creating variation from the normal in designs.

* "Internat. Arch. f. Ethnographie," vi. p. 146.

The nature of the material is apt to dictate the form under which a design may appear, and the artist may be compelled to depart from anything like realistic representation by reason of the limitations imposed by the kind of material in which he is working. In textile art this is especially apparent; in the coarser form of textiles it is impossible to represent curves, and it is in the finer forms alone that they can be represented with any degree of accuracy. This is very apparent in basket-work, and it is interesting in the case of patterns or designs whose meaning we can recognise, to see how far their form is due to the essential structure of the fabric. The rectangularity which, perforce, must take the place of the curves, which are often intended, is especially striking in designs whose motive is a representation either of animals or the

human form. However desirous the artist may be to produce true resemblances, a grotesqueness of treatment is imposed by the nature and coarseness of the textile. In the decorative designs to be seen on the basket-work of the natives of British Guiana, animal forms may often be seen, birds, frogs, monkeys, snakes, &c. The illustration here given will show the curious result of an attempt to represent a quadruped, said to be a deer, but looking more like a dog, upon the cover of a large basket-work receptacle. The coils of a snake become a kind of meander or Greek fret pattern, the curves being all squared. In some snake designs from British Guiana the tails of the snakes being confluent, a nearly complete continuous meander is formed round the basket, broken only where the two heads of the snakes are represented. In other cases

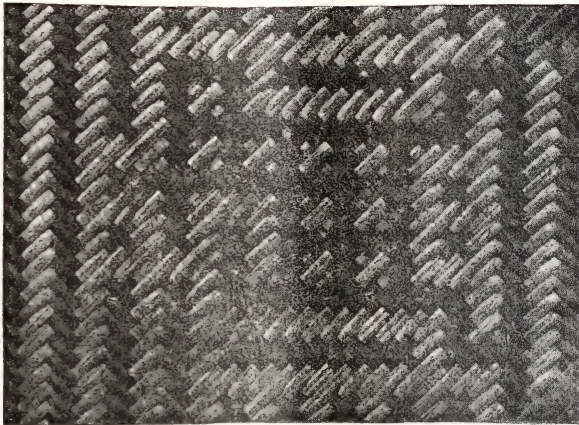


FIG. 11.

the heads are omitted, and an unbroken fret pattern is formed, running continuously all round. That actual representation should readily give place to fanciful patterns is only natural where the best efforts at producing realistic figures can only result in the grotesque at the outset. Designs woven in cloth, carpets, tapestries, &c., show the same limitations in varying degree. Those of fine texture only admit of curved and scrolled designs of such exquisite beauty as some of those described and figured by Mr. Paul Schultze in a paper read last year before this Society.

I now wish to leave the consideration of designs whose primary motive is portraiture, and especially the representations of the human and animal form, in order that I may be able to give a few instances of ornamental designs whose actual origin as such is to be

accounted for, which have, in fact, a definite *raison d'être* in the form in which they occur, as a reminiscence of their antecedents.

Where the circumstances have changed, we may frequently learn something of the earlier condition of objects by means of an examination of the form of decoration exhibited by them, and ornament thus becomes a useful clue in studying the developmental changes undergone by various objects. It is a common thing to see, as a decoration upon vessels of clay, a band of rope-like appearance running round the vessel towards the upper part. Now, in cases where clay of a poor quality has been used, there has often been the custom of using plaited or twisted bindings in order to preserve the shape of the vessel before baking, and to prevent its collapsing. These bands would leave an impression upon the soft clay,

which would be perpetuated in the baked vessel; and no doubt the rope-like bands of ornament, such as we see in the Zûni urn (Fig. 12), was suggested as a form of decoration by the actual bands formerly used, or their imprints in other vessels. Such bands are frequently to be seen adorning, and seemingly giving support to, the coarse pottery urns of ancient British times.

Where the material used in the manufacture of objects of use has been changed, the form imposed by the earlier material is frequently recalled in the decoration of the new material. To take an example: the natives of the Andaman Islands were, as they still are to some extent, in the habit of using the large shells of the bivalve *pinna* as plates for food; these are broad and rounded at one end, and pointed at the other. They have now largely



FIG. 12.

substituted dishes made of wood for these shells, and these wooden dishes are pointed at both ends, but in some the shape of the shells is suggested by the presence of a curved line in wax at one end, which seems, as it were, to cut off the pointed end beyond it, and to give the shape of the shell prototype. There can be no other reason for this curved line at one end (Fig. 13). Another example may be seen in the little "apple-gouges" still to be seen in use in the country, made from the shank bone of a sheep, partly cut away to form a long narrow gouge-like blade, and with a handle formed by the natural articular condyles of the bone. Some of these instruments are made of wood, instead of the natural bones, but, though these may be more

elaborate in make and decoration, they nevertheless, in their general form, simulate the bone shape, and the two articular condyles appear as an ornamental shaping of the handle end.

In cases where an object of use has for various reasons changed its structure somewhat, while retaining its general shape or appearance, we may sometimes see forms of decoration which have been suggested by former details of structure which have been suppressed in the new forms. Thus, there is the case of some air-guns, with which, some time ago, an Austrian regiment was armed, in the place of the more usual firearm of the period. These being *air-guns* no longer required to be fitted with an external lock and lock-plate, but the absence of the latter seems to have been regarded as detrimental to the appearance of the weapon, and we find the outline of a lock-plate *engraved* upon the breech end of the gun at the point where the

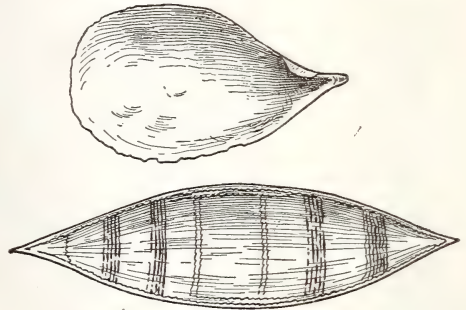


FIG. 13.

actual plate would have been had the propulsive agent been gunpowder. I am not sure that some of our modern "hammerless" guns do not show somewhat kindred external ornamentation. A very similar instance of "survival" in ornament is seen in the case of some well-known forms of Greek and Etruscan helmets, in the early forms of which we see a space between the cheek-pieces, communicating above with the two eye-holes, which are separated by the bar protecting the nose (Fig. 14, 1). The warrior's head and face were completely encased in such a helmet. No. 2 is a very similar form. No. 3 shows the space between the cheek-pieces broken by a transverse bar, which connects and supports the edges of the cheek-pieces. In No. 4 only a trace of the space remains below, and in No. 5 this is obliterated, and the only open spaces remaining are for the eyes and under the nose-bar. No. 6 shows a helmet

of a kind no longer intended to cover and protect the face, but only as a head covering, but we see in the decoration of its surface an engraved representation of the eye-holes and nose-bar, and a line running from these in the position once occupied by the gap between the cheek-pieces, thus preserving the memory of their former usefulness. Modern tailors perpetuate the memory of what was once a *useful* appendage to a coat, when they add as finishing touches the two buttons which we see upon men's coats in the region of the small of the back, and the shape of the coat collar and flaps is often only *suggestive* of a possibility of buttoning the latter across the chest when desired, as the shape is just sufficiently modified to prevent this being actually done, the button-hole being solaced for the loss of the button with which



FIG. 14.

in former times it would have been mated, by being made the recipient of the small bunch of flowers which adopts the name of its holder.

I will now conclude with an example of a form of decoration which owes its origin accidentally to a process in the manufacture of the objects which it adorns. The natives of the Solomon Islands, from whose art I have already drawn more than one example, make their long arrows with shafts of bamboo. The roughness of the nodes upon the bamboo proving inconvenient in shooting, these are usually pared down so as to render the whole shaft smooth. The fibrous structure of the bamboo causes a liability for narrow strips to peel away when started by a cut, and we see arrows in which numerous narrow lines of varying length are grouped round the node, caused by this accidental stripping. In the

course of the use of such an arrow, the stripped portions become darkened, as they readily take up any dirt or other colouring matter, whereas the smooth siliceous exterior remains clean. These darkened groups of long and short lines were evidently accepted as a suggestion for decoration, as we see that they have been copied with a more careful regulation of the length of the lines, which are grouped in graduated series and purposely darkened with black pigment. The paring of the node is performed by a separate process, with greater care to prevent peeling as before, in order not to encroach upon the derived ornament. Next came an increase in the number of the groups of lines, which are now often produced by *scraping* and not peeling. At a later stage the lines are finely *incised*, the number of groups increased, so that their bases become fused. Later still, the groups are more completely fused, their apices alone being separate; and, lastly, we get complete fusion, the lines, all now of equal length, forming a complete band round the shaft, just above the node. This band appears under a great many varieties, in accordance with the varying tastes of the artists.*

In bringing to a close this very brief and imperfect survey of a wide subject, I will only add that, although I have, in order to avoid possible complexity, selected for my illustrations of the various developmental processes, examples taken for the most part from the art of the lower races of mankind, the same processes may be seen at work in the art of the most highly civilised people, with much the same results, and we have only to study with a little care the examples of decorative art which everywhere surround us, and are always at hand, to discern traces of a developmental history, which is often as startling and curious, as it is interesting and instructive.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said that Mr. Balfour had favoured the Applied Art Section of the Society of Arts with a paper of high scientific quality, to which they had listened with the deepest interest, and for which he had earned their most grateful thanks. It was difficult to offer any criticisms on it, for Mr. Balfour had treated his subject in so severely inductive a manner that one had to accept his conclusions, from the facts so carefully established by him, as self-

* This series was originally published with a plate in the "Journal Anthropological Society," xvii. p. 328.

evident principles. Moreover, while the traditional types of decorative art were yet in their mechanical stage, and were merely so many dead forms, and before the quickening spirit of art had breathed life and beauty into them, and they had thus become truly decorative, they excited no artistic sympathy in him, even though they might already have become symbolical. In his opinion, indeed, Mr. Balfour's most instructive paper belonged not so much to art as to ethnography, and for this reason the observations he ventured to offer would rather be round about than on the admirable paper they had been privileged to hear that evening. The paper really dealt with changes in decorative types rather than with evolution in decorative art. The fact is that in art there is no such thing as evolution, but more or less isolated and veritable "creations"—for their law cannot by searching be found out—by men whose genius is a true divinity. These men found schools, and styles, and, after them, begins a regular course of devolution, at every step worse devolved. This is really as true of "decorative" as of "fine" art; while the facts of devolution are even more strikingly and pertinently illustrated in historical than in unhistorical (*i.e.*, "primitive" and "savage") decorative art. Thus, Sir John Evans has shown [*Numismatic Chronicle*, xii. 127] the type of the laureated head on the gold stater of Philip of Macedon, in its passage through southern, central, western, and northern Belgium, Gaul, and across the Channel into Britain, passing through successive devolutions under the hands of its savage, or, rather, barbarous imitators, until it becomes in one series an ear of wheat, and in another a quatre-foil. Of course there may be change without devolution of type, and change with evolution, as when the Greeks took the symbolical palm head of the Assyrian "Tree of Life," which owes all its interest to its symbolism, and transfigured it, unfortunately, with the loss of its symbolism, into both the "palmette" and the "honeysuckle," two decorative types of perfect beauty, and, indeed, rather created, after an ideal archetype, than evolved from a material prototype. For illustrations of changes in well-known types of historical decorative art, he referred to the chapter on "The Knop and Flower Pattern" in his "Industrial Arts of India," and to Count Goblet D'Alviella's "Migrations des Symboles," which latter treated of the permutations of every known symbolical decorative type in at once the most learned and scientific manner. The Polynesian types dealt with by Mr. Balfour he (the Chairman) thought might be instances of evolution from devolved types, originally Indian, transmitted through Southern Asia. There was first ignorant and unskillful imitation with gross devolution of type, and from that point there was a limited degree of evolution, for the human mind, even in its lowest developments, insists on coherency and symmetry, so far as it can command them. If we will search out the absolutely aboriginal sources of

decorative types we must go back to the utmost backward of the world's history, beyond the genesis of the human race, of even the animal kingdom, and trace them to the ultimate molecules of the eternal elements of infinite Nature! There is no intermediate point of origin either in the "evolution" of decorative types, or of the æsthetic sense they gratify. The æsthetic sense is in short inherent in nature, and latent throughout nature, and he (the Chairman) would not limit the point at which it became nascent and conscious. In form, we can trace in nature everywhere a tendency to the evolution, through successive gradations, of ever more and more perfected beauty. For an instance, take the peacock's plumage—wherein we can trace, through successive steps, the gradual evolution of its decorative type, from its first remote suggestion, in a vague spot of blue on the tips of the bronzed green feathers of the body of the bird, to its final complex elaboration of form and colouring in the characteristic "eye" of the feathers of the tail: and the pea-fowls sense of their beauty is proved not simply by the peacock's proverbial pride, but by the fact that peacocks are now all distinguished by "eyed" plumage, simply because the peahens have always preferred handsome to plain mates, and refused the latter all opportunity of multiplying their plainness. Similarly, peahens are now all dingy hued, because the more brilliantly coloured ones were so run after by the peacocks that they were all sterilised, and long ago became extinct. This law of sexual selection reigns, with rare exceptions, throughout the animal kingdom, below men and monkeys, and sufficiently demonstrates the presence of the æsthetic sense throughout it. Then, passing to colour, we find in vegetation its fundamental colour to be green, but by some law, that is, property of plants, they all, in the higher orders, tend to express themselves in ever nobler developments of colour; and first, after green, in yellow, and then, through orange, in red, and through purple in blue, the noblest of all colours. Of course, the unit of a flowering plant is the leaf, a tree being nothing more than a colony of individual leaves, and the successive modifications of the leaf into the calyx, corolla, stamens, pistils, and ovules, or, after fertilisation, seeds of a flower, is simply to provide the embryo leaf, which is the heart of heart of the seed, with sufficient protection and provision against the winter, and other risks, to ensure the propagation of the plant in the spring. These modifications imply higher and higher efforts of generative force, manifesting themselves naturally in higher and higher developments of colour as well as of form. But still it is impossible not to feel that every flower rejoices in its own beauty, and that its joy is essentially of the same kind as our own, at least in so far as it is an elementary mood and aspect of it. Note the phenomena of the fertilisation of a flower. It is quite a fashionable wedding "feast of nectared sweets, where no crude surfeit reigns," the colours of the corolla representing the gay dresses of the bride and bridesmaids, the fluttering

butterflies the banners, and the humming of the bees the marriage bells. In its anatomy and physiology, and one might almost say in its scenic arrangements, and social economy, it is all one with a human marriage, and it is hard to believe, in the face of such suggestions of a universal *amnia mundi*, that the predominant sentiment of the two functions is not identical, and that plants do not participate in the artistic sense common to all animals, and are not in some degree conscious of their own ministry to the beauty and nobility of the life of this world. There always seems to me more than a latent æstheticism even in gems and other crystalline and coloured stones, their very beauty being, as it were, expressive of the ceaselessly operative tendency, which might almost be called the insuppressible desire, of the whole material "creation" to realise its highest spiritual ideals.

Mr. HUGH STANNUS said he also had been much interested in the paper, and knowing Mr. Balfour's book, he had looked forward with much pleasure to hearing it. No one would attempt to traverse the main positions put forward, but could only, so to speak, attempt to embroider some corroborative instances on the main web. Mr. Balfour had spoken of the manner in which savages observed partial resemblances in natural objects, and with the aid of art improved those into more perfect resemblances, and he had in his mind an instance in Santa Maggiore at Rome. In the Corsine chapel, in the grain of one of the marble pilasters, there was something which looked very much like the head of a donkey, and was always pointed out by the custodian, but on examining it carefully he was quite able to detect that it had been touched-up, so that it owed the likeness as much to art as it did to accident. He thought the explanation of the manner in which a pattern had been altered by successive copyings was a perfect demonstration. It was the accumulation of the errors which made so extraordinary a difference between the first and last of the series. The change from the snail to the bird reminded him of a game in which one person whispered a sentence into the ear of his neighbour, which again was whispered round the whole circle, and of course it came out quite different at the other end. If he recollected right it was Thackeray who described how Dionysius Lardner, at a great house, gave his name to the flunkey at the bottom of the stairs, but by the time it had been passed on to the top he was announced as Ignatius Loyola. In point of fact the human mind could not bear anything incoherent; and if it did not see a meaning in a word or expression, it made one. This accounted for the examples which had been given. The same thing applied in the change of name in tavern signs, as for instance the "Bull and Mouth" he understood was a devolution from Boulogne mouth. Another interesting parallel is the very remarkable Scandinavian ornament alluded to by Herr Hans Hildebrand, the royal antiquary

of Sweden. He showed how the curiously involved ornaments, with a mouth at the end of a scroll, which look as if they were serpents, were really developed from the Roman lion as the prototype; and it was shown how these patterns had come from old Roman coins of the time of Constantine, or, perhaps later, and gradually became changed in form. The well-known little book of Japanese crests quite bore out everything Mr. Balfour had said. The practice is the same in England, where, when a herald had to find arms for a different or younger branch of the family he would add some device "for difference," according to the heraldic expression. Reference had been made to decorative features which were retained, although they were of no further use, and that seemed to be a parallel to the manner in which old families, when their servants were no longer able to perform their functions, kept them on as pensioners. He ventured to think that many of these decorative features were now simply pensioners. For instance, the facings on the uniforms of soldiers; in former times the cuff was turned back in action, whereas that was now reproduced in the uniform by coloured cloth. He thought the instance given of the engraved lock-plate on the barrels of the air-guns might be necessary for the soldiers who were accustomed to the old pattern, that they might know exactly where to put the hand in the Platoon exercise, presenting arms, shouldering arms, &c., and so in this case it might not be altogether a pensioner but the actual functional part of the weapon used by the drill-sergeant. All art had probably arisen from two principles, *similarity*, which gave rise to pictorial art, and *regularity*, which gave rise to the art of decorating beautifully. In the boomerang was seen the principle of regularity, and so also in the decoration of the arrows; but in the improving the portrait it was a case of similarity. Each principle was interesting, and he would suggest that it might be well to separate these two in dealing with evolution. There was the art which created storiation, which arose from observing; and the regularity which arose from a desire to beautify. All those who had to deal with art in a didactic manner were indebted to those who, like Mr. Balfour, applied the scientific method drawn for anthropology and ethnology, to the early roots of art which lie so far back in the past. A useful way in considering art in early times was to observe the arts of people who were still in the early stage of civilisation, and just as in observing savages we might find facts which illustrated the early history of pattern work, so also in children, who were a kind of savage, we saw the liking for pictorial resemblance rather than for decorative treatment, which was explanatory of many of the phenomena observed.

Mr. PHENÉ SPIERS said he was acquainted with Mr. Balfour's book, but was very glad to have had the opportunity of hearing his paper and seeing the

illustrations on a large scale, which enabled one to realise much better the lessons to be drawn from them. For instance, in the illustrations of the Virginian dance the first drawing showed the figures actually dancing, but the last one appeared to show them walking up to the centre, which was a different movement altogether. Mr. Balfour had dealt chiefly with pre-historic periods, and it was only in one of those patterns derived from basket-work and in the spear-heads that one could recognise the beauty of design and colour. He was reminded by them of the saying of a friend, who stated on one occasion that whenever you looked at any design or pattern in which the colours were badly contrasted and the forms ugly, in which, in fact, there was almost every fault, and you made careful inquiry, it was found that that pattern was evolved by a highly civilised nation. If, on the other hand, you found beautiful colours harmonising well together, with simple and graceful forms, you might be sure that it was produced by savages, and most probably cannibals. That was a striking example of the danger we had to go through in civilisation. One point which might be carried to a greater extent was the one which suggested that many decorative patterns were derived from basket-work. He had never seen that so clearly as in the slides showing imitations of the serpent and the monkey, which bore a very distinct resemblance to the Greek fret. This kind of ornament was found in all countries, and it was very common to say that the Greek fret had been copied, but there was no doubt in many cases it was much earlier than the Greek period. There was no doubt that each nation had evolved the same type in this way originally taken from basket-work. Mats, again, had certainly evolved a number of patterns. In the British Museum there were specimens of carved pavement slabs from Assyria, obviously copied from some kind of matting or weaving.

The CHAIRMAN having proposed a vote of thanks to Mr. Balfour, which was carried unanimously,

Mr. BALFOUR, in responding, said that he thought Mr. Stannus's objection to the nature of the ornament in the Austrian air-gun was hardly borne out, because the parts of the gun were sufficiently indicated by the nature of the stock, which was the same as in the fire arm; the trigger also was in the usual place. Besides it was surely quite unnecessary to repeat it on both sides. He had met some very curious examples indeed of resemblances to natural objects. He had himself the end of a nodule of flint from Brandon which exactly resembled the head of a pigeon. The eye was in the right place, and the beak corrugated at the base just like a carrier pigeon's. It only required a stuffed body and legs to make it quite realistic. He had also been shown by an American lady a curious little stone from Ober Ammergau, about half an inch long, which showed nothing whatever when held in every position but one, but

there it bore a perfect resemblance to a human head and face. He heartily endorsed the remarks made about savages being better skilled in the proper adaptation of ornament than civilised men, and should like to have pointed out how strongly marked this was in savage life, and how well adapted their ornament was to the object which was decorated. The Greek fret, and various patterns which so closely simulate it, must have originated in a variety of ways, and he should not like to lay it down that the squaring of the snake design through wearing was the origin of the Greek fret. He should rather follow General Pitt Rivers in his belief that the Greek fret and the meander were derivatives of the "looped coil" as represented in the squared form, probably due to the attempt to represent coils, in some material which did not admit of their representation with accuracy. One constantly noticed the transference of textile patterns to other materials which were entirely different, and to which they were unsuited. For instance, we often saw very good basket patterns on pottery, and, except that one might suppose that in some instances pots were formerly made inside baskets, to assist in the manufacture of what was then probably a somewhat difficult material to work, one must suppose that the case was simply one of transference of design applied originally to one material to an entirely different one. He of necessity took a more or less strictly anthropological view of the subject, but he thought that modern applied art could be brought closely into connection with anthropological suggestions. The paper was intended to be suggestive, and not only purely descriptive as it might appear, and there were many things he should like to touch upon in greater detail, but a paper which attempted to cover rather too wide a field was apt to become somewhat of a race with the clock, which always won, and therefore it was desirable to keep one's remarks as concise as possible, in order, if possible, to come in "a good second."

Mr. ALAN COLE writes:—I was prepared to speak on "Evolution in Decorative Art" from the æsthetic side, but as Mr. Balfour treated it from the anthropological side I felt, when called upon by the Chairman, that my views would not entirely fall in with the current of thought thus started. Being invited to send in my remarks on the former point, I forward for publication the following memorandum:—A theory of evolution seems to me to aim at expounding a progress from simplicity to complexity, and even *vice versâ*. Simplicity is usually found with primitive people, complexity with cultivated people. But simplicity, showing the exercise of that highly artistic quality of restraint, distinguishes sculptures by Greeks at a period of high cultivation. And on the other hand lavish complexity is characteristic in monuments of decorative art, produced by such comparatively rude and uncultivated people as the Aztecs

or Toltecs. The evolutionist must, of course, be prepared to meet and deal with such apparent perplexities. To do so, it seems to me that certain axioms and postulates must be granted; and some agreement must be come to as to the meaning of terms, such as proportion, contrast, balance, grace, and other debateable definitions. With tenable axioms, postulates, and definitions we can analyse up to a certain useful point, the qualities of all works of art. The method is familiar to us in Euclid, but not generally so in æsthetics. Oliver Goldsmith writes that "the schoolmen had formerly a very exact way of computing the abilities of their saints and authors. Escobar, for instance, was said to have learning as 5, genius as 4, and gravity as 7. Caramuel was greater than he; his learning was as 8, his genius as 6, and his gravity as 13." In a similar and, I think, more suggestive way for our present purpose, Laurence Sterne analyses a dedication he proposed for Tristram Shandy, "Measuring it in the painter's scale divided into 20," he considers that the outlines of it "will turn out as 12, the composition as 9, the colouring as 6, and the expression as $13\frac{1}{2}$." He concludes with the design saying, "If I may be allowed, my Lord, to understand my own design, and supposing absolute perfection in designing to be 20, I think it cannot well fall short of 19." However playfully intended, there is clearly a scientific pretension in this method of differentiating the values of qualities in works of art, and bringing them under a common numerical denominator. The method involves cautious computation and close observation, which are of essential importance to the theorist in art, though not altogether so to the artist, whose feelings stimulate his productiveness, whilst from his productions the theorist deduces his ideas of their qualities. But to give full exercise to a method of valuing relative conformity to the theorist's standards, the range over artistic productions should be as wide and as unfettered as can be. Conventional notions as to periods or national styles of art must be dismissed. The problem is to arrange in one order different expressions of art, and to ascertain their order or evolution by correlating their qualities: the comparative clumsiness of sculptures by old Indian Buddhists must be weighed with the elegance in sculptures by Ancient Greeks, and both brought into line with the realistic accuracy, say, of modern Frenchmen and Italians. Then, in explanation of evolution, due consideration should be given to the endless influences affecting artistic production. A curious and suggestive incident of the uprising of something that came to be accepted as ornament occurred some four centuries B.C. in Thrace through the intermixture of Thracian and Scythian tattooing on the bodies of Thracian women. The Scythians' tattooing was regarded as a degradation by the Thracians, who intermingled other tattooing with it and raised it in the eyes of the Greeks to the dignity of ornament. The anecdote is given by Athenæus. The type of

ornament was probably not so *bizarre* as the tattooing on an unfortunate nobleman or prince, exhibited some year or so ago at the Crystal Palace or the Westminster Aquarium. The story, however, is suggestive of how ornament may arise. Arousing a different consideration is the typical Græco-Bactrian heads of Buddha, in which the arrangement of the hair is Greek in treatment, whilst the type of face, with small moustache, is distinctly Persian. Here we have an instance of a work of art proclaiming the influences of its production. In classifying types to illustrate an evolution series, time and place of origin, as I have suggested, can have no weight. Apart from ornament, like the key and wave pattern, and many other almost universal devices, the repetition and variation of which have arisen independently, as well as very largely from imitation, there are many forms which, springing from a common source apparently, are, nevertheless, equally apparently independent of one another in their production. An instance of this occurs to me. It relates to an ornamental arch, supported by stunted and wide pillars—incised by some Coptic mason into a flat slab of stone about the 6th century, A.D. The same device, with corresponding defects of proportion, abound in incised woodwork of our Jacobean period. Both objects are doubtless referable to a Roman source, but it is difficult to connect the taste of the British Jacobean furniture-maker for a quaintness in proportion, ornamentation, and mode of expressing it, with a similar taste on the part of the Coptic stonemason living in a remote Egyptian district some 1,100 years earlier. In an evolution these two examples would be classified together as of the same stage and illustrating the same type of art.

FOREIGN & COLONIAL SECTION.

Thursday, April 19, 1894; Sir ROBERT HERBERT, G.C.B., Agent-General for Tasmania, in the chair. The paper read was, "Tasmania and the Forthcoming Hobart International Exhibition, 1894-95," by G. COLLINS LEVEY, C.M.G.

The paper and discussion will be printed in the next number of the *Journal*.

NINETEENTH ORDINARY MEETING.

Wednesday, April 25, 1894; FRANCIS COBB, Treasurer of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Abney, Captain William de Wiveslie, C.B., F.R.S., Willeslie-house, Wetherby-place, S.W.

Dolman, Osmer S., 32, Dryden-chambers, 119, Oxford-street, W., and 5, New Compton-street, Soho, W.

Eve, Richard, Aldershot.

Fuerst, Jules, 17, Philpot-lane, E.C.

Hussey, Charles, Uphaving, Hornchurch, Essex.

Mansell, Thomas, St. Thomas's Hospital, S.E.

Parkyn, Walter A., North London Scholastic Institute, Burgoyne-road, Haringay, N.

The following candidates were balloted for and duly elected members of the Society:—
Fairfield, Edward, C.M.G., 7, Park-place, St. James's, S.W.

Walpole, George, 89, New Bond-street, W.

Ward, H. Snowden, Hawthornden, Woodside-park, N., and 6, Farringdon-avenue, E.C.

Ward, Mrs. (Catharine Weed), Hawthornden, Woodside-park, N.

The paper read was—

SOME RECENT ADVANCES IN PHOTOGRAPHIC CHEMISTRY.

BY CHAPMAN JONES.

Photography, as ordinarily practised, is an empirical art. Although it is founded upon, and intimately connected with, certain branches of chemistry and optics, very few photographers know anything of these sciences. The ordinary practitioner, whether amateur or professional, works entirely by rule of thumb, and is guided by tradition rather than by reason. It is natural, and perhaps necessary, that this should have been so at first, but it must be allowed that the sooner the art is put upon a sure foundation the better, though doubtless there will always remain some who will prefer the old ways.

There is now a larger amount of scientific work being done in connection with photography than heretofore, and I would suggest that the time has come when we should make a determined effort to get rid of uncertain and obscure processes in serious work. When one's only aim is amusement, then, of course, there must remain free liberty to follow any fancy, but for the production of valuable records of any sort, whether pictorial or otherwise, I think the time has come when photographers ought to avail themselves to the fullest extent of all the scientific knowledge at their disposal. Any who are unable to guide themselves should, as is usual in other industries, seek the advice of those who are able to give them assistance.

As an example of the disastrous effects of working in the dark, I may say that I have heard of photographers, both amateur and

professional, who have many large and valuable negatives intensified by the mercury and silver cyanide process that have so much changed from their original condition as to cause grave anxiety. It would have been wise, though perhaps hardly possible, if photographers had declined to use this process until it had been properly investigated by a chemist. Then no trouble would have ensued.

We may for convenience sake, with reference to the majority of photographic operations, divide the photographer's work into two parts, namely, the making of the negative and the making of the print. If we except those cases in which, for scientific purposes, the negative itself is preserved as the record, as, for example, in spectrum work, then the end and aim of the photographer is the preparation of the print, and the negative is nothing more than the tool used in its production. In this sense, therefore, the print is of much more importance than the negative. It should be of a permanent character, while the tool used in the making of it may perfectly serve its purpose, though it were so short-lived as to fade away immediately after it had yielded the print. But it is convenient, and often of great importance from an industrial point of view, that the negative shall be stable. And if the negative is not right the print must be wrong, and if the negative is produced by uncertain processes we never can tell what the print will be. The science of negative-making becomes therefore, I think, of as much importance as the science of printing processes. As the chemistry of these latter has received enough attention to enable anyone to make prints that are perfect from a chemical point of view, while the chemistry of negative making has been very largely neglected, I have spent a good deal of time during the last few years in examining some of the operations in common use, and propose this evening to look at one or two matters in connection with the chemistry of negative-making on gelatine plates.

The silver bromide particles held in the gelatine film are so changed by suitable exposure to light, that the developer is able to take away the bromine from them. In a chemically perfect negative, after fixing and washing, the image will consist of pure metallic silver, and it does not matter at all where the bromine has gone or what changes it has produced in the developer so long as no trace of it, or what it leads to, remains behind. But when bromine is added to an alkaline solution of pyrogallol acid, it produces a brown colour, and as there

is most bromine removed where there is most silver deposited, the brown colouring matter will be, roughly speaking, proportional in quantity to the density of the negative, unless some of it is removed. There is, perhaps, no *prima facie* reason why an image of this composite character should be objected to. Indeed, the presence of this brown stuff may improve the negative if the film has too little silver in it to give proper density alone, or if the exposure has been too short to change a sufficient amount of the silver bromide into the developable condition, or if the development has been unduly curtailed. It is easy to see, therefore, that a cheap manufacturer, and an incompetent, rule-of-thumb photographer, may have definite reason for advocating the use of stain-producing developers. But to rely upon staining matter in the making of negatives is to lean upon a broken reed. The residues obtained by the partial destruction of some complex organic substances are almost pitchy in character, and seem to be very unalterable by ordinary atmospheric influences. But the staining matter produced by the oxidation of developers, so far as I have yet discovered, is never of this kind. Pyrogallic acid generally yields brown products, inclining sometimes to red and sometimes to yellow; but twice I have obtained solutions of so fine a deep blue colour, that it might have been mistaken for Prussian blue. These blue colours, on standing for a few hours, faded to a yellowish brown. The deep reddish brown colour obtained by simple aerial oxidation of a solution of pyrogallic acid and sodium carbonate, becomes perceptibly lighter in a day or two when bottled up, and in a week or so may have lost perhaps half the depth of its colour. I think one is quite justified in saying that neither the quantity nor the quality of these staining matters can be controlled, that they are in every way uncertain, and that, therefore, they ought to be rigorously excluded, or perfectly removed, from every negative of value.

And these are far from being all the reasons why the presence of staining matter in negatives should be avoided. A silver image is reliable, and can be chemically worked upon with perfect certainty as may be desired. But staining matter cannot form a foundation for after work, and it will suffer change with almost every operation upon the negative. Its colour will change and rechange, and by washing it will, under some circumstances, be partly removed. We know very well that when a part of the image is removed by

applications to the surface of the film, the shadows lose a greater proportion of density than the lights because the dark detail is in the upper or outer service of the film only, and so is more easily attacked. Therefore, granting for the moment that a negative with an image that consists partly of staining matter has correct gradation, if a part of the staining matter is removed the gradation will be falsified, and this alone would be sufficient reason for condemning the use of staining matter in negative-making.

There is another source of staining matter, namely the oxidation of the developer by its exposure to the air during development. The colouring matters so produced may or may not be the same as those resulting from the action of bromine, but, so far as my experiments go, they behave in a similar manner with reference to those changes that are of practical interest to photographers. The darkened solution will soak into the gelatine and colour it more or less uniformly, and it appears that it may perhaps also intensify the image by deposition upon it, if we take into account recently published experiments. Mr. A. W. Dolland* has shown how by the use of glycerine, gold may be deposited upon the metal in a platinum print, the platinum apparently remaining quite unaffected, and merely determining by "contact action" the precipitation of the gold from a solution that is ready to deposit it upon the least disturbance. Mr. E. J. Wall† has confirmed the results of earlier workers, who found that silver might be similarly deposited. And, coming still more closely to the point under discussion, Dr. R. E. Liesegang‡ has recently observed that substances of the nature of pigments may be deposited upon a metallic basis in an analogous manner. He found that the staining matter produced by the aerial oxidation of pyrogallic acid, hydroquinone, and similar substances in alkaline solution, would deposit upon and intensify the image of a silver print. A solution of amidol with carbonate of soda he found would deposit coloured oxidation products upon the image of a platinum print. It is, therefore, but natural to suppose that probably sometimes the staining matters produced by aerial oxidation in developers will deposit upon the image in negatives, and add to the oxidation products that are already there, produced by the action of the bromine, as before

* "Journal of the Photographic Society," N.S. xviii. 189.

† "Journal of the Photographic Society," N.S. xviii. 184.

‡ "Photographic Work," iii. 121.

described. I have made one experiment in this direction, by soaking part of a negative in an alkaline solution of pyrogalllic acid, allowing it to remain until the solution and the negative were both well coloured, and then washing for a short time. The colour, of course, retarded printing, but I could not discover any intensification effect. It is possible that the staining matter produced by aerial oxidation may attach itself more readily to the image when the image is freshly formed, or it may be that it does not attach itself to the image at all under the conditions which hold during development.

Every photographer knows how to set to work to avoid the production of staining matter, but I think that very few know how to get rid of it when it is in a negative. The usual method is to apply an acid solution—a so-called “clearing solution.” The stain may disappear, and then the photographer imagines that it has gone. The error of this empirical and rule-of-thumb method can be easily demonstrated. If hydrochloric acid, sulphuric acid, sulphurous acid, or alum, is added to an oxidised alkaline solution of pyrogalllic acid, the brown colour is changed to a lighter brown, and immediately a yellowish insoluble matter begins to fall out of solution, and continues to increase in quantity for some considerable time. In a negative where there is not much stain this change of colour may cause it to disappear, and the superficial observer would then think that he had got rid of it, while really he had made it, or a large part of it, more permanent than before by rendering it insoluble. It is easily shown that this precipitated matter generally constitutes a very important part of the staining material, by dissolving it in carbonate of soda and comparing the colour so obtained with that of the original, or of the part not precipitated. Citric acid differs from the acids mentioned above, in that it gives no precipitate, but citric acid and alum together give a copious precipitate even when the quantity added is many times more than sufficient to render the solution strongly acid.

It appears, however, to be possible in aggravated cases to get a small residuum of stain from the use of pyrogalllic acid, and rather more from the use of hydroquinone, which it is very difficult indeed, if not impossible, to remove. This residual stain I find to be quite unaffected in appearance by any of the usual clearing solutions, unless they contain iron, and then the colour is somewhat changed in

tint, and, if anything, a little darkened. It may be remarked also that staining matters vary somewhat, and that exceptions may be found to the results that I have described, but I believe that such exceptions, if any exist, will be found so rarely that it will be practically impossible to take cognisance of them in framing rules for general work. Ferrous oxalate has often been recommended as the most perfect developer when stainless negatives are desired, but although ferrous oxalate is a very useful reagent, I cannot confirm the superiority that is claimed for it. Every developer in use will give clean, greyish-black negatives if properly employed, but by making a careful comparison of ferrous oxalate with eikonogen on a plain gelatine film, I find the iron developer to leave a slight colour, which is very difficult, if at all possible, to remove, while the eikonogen leaves none. I have no doubt whatever that metol, amidol and rodinal, would all show a like, if not a more marked, superiority. It may be observed that in making such comparisons it is necessary to use a simple gelatine film, because the stain left by ferrous oxalate, when it is applied in the same manner as is usual in development, is easily masked; and it should be understood, too, that the difference is slight. Still, what difference there is, is in favour of the alkaline developer.

The rules for practical work that I have deduced from my experiments I have followed for some years with uniform success, nor have I ever heard of dissatisfaction from those who have accepted my suggestions in this matter. I believe that the greatest freedom from stains due to the developer is secured by the use of an alkaline developer with sufficient sulphite, and fixing in a solution of hyposulphite to which sodium sulphite and sodium carbonate have been added. A very few minutes washing between development and fixing is sufficient, but the fixing solution should not be used after it gets dirty or discoloured. After thorough fixing should follow a thorough washing, and with a well-coated plate this will be a matter of two or three hours or more. By this method any staining matter is kept in its most conspicuous form, and in its soluble, and therefore most readily removable, condition; and it must surely be allowed that this is the right principle to work upon. Alum should never be used until the washing is finished, because it retards the washing; so-called “clearing solutions” should not be used, both because they tend to make the stain less obvious, and

they make its removal impossible; acid fixing baths should be avoided for the same reasons, and if they harden the film their use is still more detrimental, because in doing so they render the washing more tedious or less perfect.

Having obtained a pure silver image, it may be found that its density is not suitable. It is well that the density should never be too great, because there is no practically useful method of reducing it that does not alter the gradation. On the other hand, intensification is certain and easy, and does not falsify the gradation, when done in a suitable manner. In papers read before the Photographic Society and the Society of Chemical Industry, I have detailed the chemistry of mercurial intensification, and shown that ferrous oxalate is the only reagent that can be relied upon to follow mercuric chloride. Potassium silver cyanide is not suitable, because the image it gives is not of constant composition, and is not permanent; ammonia is unreliable, because it gives images of complex and varying composition, which cannot reasonably be expected to be permanent; all simple alkalies are out of the question; sodium sulphite gives a pure metallic image, but in smaller quantity than the original image, and often, therefore, gives no intensification effect; sodium hyposulphite also gives an image containing a less weight of metal than the original, and, besides, is likely to give very complicated unstable images if used sparingly. Ferrous oxalate, on the other hand, is a perfect reagent, leaving every atom of silver in the original image with an atom of mercury added to it.

The most excellent point of this method of intensification is that, so far as I can discover, there is absolutely no loss of even the faintest detail, but a perfect and proportional action throughout. But this very excellence has proved a drawback in the hands of dirty workers, and workers with unclean plates. A silver stain will be intensified as well as the silver image, and must be so if the action is perfect. I know of no failure by this method not due to imperfect washing or other faulty work. But some photographers say they have found alkaline developers, or alkaline developers without the alkali (if the expression will pass), better than ferrous oxalate, and they have recommended these reagents, I am sorry to say, without a knowledge of their action. If they work as they are stated to do, "cleaner" than ferrous oxalate, that is a

pretty sure indication that they are less perfect, unless the only difference is due to the precipitation of the lime in the water when oxalate is used. I have tried many of these solutions, and none of them are reliable. By the use of them, mercury that ought to be in the image is lost, and one cannot tell how much mercury will be so lost, nor from what part of the image it will come. It is hardly conceivable that the mercury lost can come proportionately from every part of the image, and if the loss is not proportional throughout, the density gradation of the negative is upset.

Sodium sulphite, when applied alone, removes both silver and mercury from the bleached image, but with a developing agent, whether with or without alkali, I have never found any silver in the solution.

Eikonogen alone I found to act very slightly. With sulphite a great deal of mercury was lost. Eikonogen 12 grains, sodium carbonate 25 grains, and sodium sulphite 25 grains, to water 1 ounce, acted well, but 19 per cent. of the mercury was lost. Metol alone gave no perceptible action. Metol 2 grains, sodium sulphite 4 grains, to 1 ounce, acted well, but very much mercury was lost. Metol 4 grains, sulphite and carbonate 24 grains each, to 1 ounce, acted well, but 32 per cent. of the mercury was lost. Amidol 2 grains, and sulphite 20 grains to the ounce worked well, and 10 per cent. of mercury was lost. This appeared hopeful, so I tried amidol 8 and sulphite 20, but this was useless, as its effect was very slight indeed within a reasonable time. So I diminished the amidol instead of increasing it, and tried amidol 1 and sulphite 20. This worked well, but 42 per cent. of the mercury was lost. On mixing the amidol and sulphite, sulphurous acid is set free. By adding ammonia to the mixture a blue colour appears when the alkali is in a little excess, and by adding ammonia in quantity, just insufficient to produce this colour, a solution may be prepared that will remain slightly alkaline throughout the reaction. Such a solution acts very energetically, but a very large quantity of mercury was dissolved by it. Pyrogalllic acid 3 grains, sodium sulphite 8 grains, ammonia 3 minims to the ounce, gave a loss of 29 per cent. of the mercury, and the solution was much more coloured than in any other case. Pyrogalllic acid with sulphite slightly acidified was no better.

In some cases, as stated above, I have estimated the actual proportion of mercury in the solution, and therefore lost from the image,

but these numbers must be taken as only giving a general idea of the amount. In some cases, by prolonging the action a little it would have been increased, and probably in no case would the same loss occur by repeating the experiment.

Thus I am obliged to come to the same conclusion now that I did when I first drew attention to the chemistry of mercurial intensification, namely that ferrous oxalate is the only satisfactory reagent to follow the application of mercuric chloride. I show an example in which this method of intensification has been carried out on various parts of the same negative, once, twice, three times, and four times, without a suggestion of stain or trouble of any sort. It should be noted that this repeated application of the process is a very severe test of its cleanness when properly carried out. If there had been the slightest false deposit of mercury at any stage, this would have been doubled by the next treatment, and increased to four times and to eight times by successive treatments. Silver would have increased similarly but to a still greater degree. I could show many negatives intensified by this process, but they are similar in appearance to unintensified negatives and therefore would not be instructive.

There is only one other matter that I will refer to at present, and that but briefly, namely, the getting rid of the hyposulphite from the negative. Experience appears to indicate that if a negative is of a satisfactory density, the small amount of hyposulphite left in it after from two to four hours washing does no harm. But if the negative is to be intensified, any hyposulphite will cause a precipitate of mercury salt, and so give a false deposit. This would, as a rule, matter but little, but for the fact that a gelatine negative is always difficult to wash evenly, and such a false deposit will, therefore, almost always occur in patches. If the gelatine film is of exactly the same thickness throughout, equal washing all over is difficult, but in most plates there are variations in the thickness of the film that make it impossible, unless it is so prolonged as to be practically perfect in the thickest parts. What we want is a reagent that will oxidise the small residue of hyposulphite into sulphate, which is quite inert, without affecting the image or attacking the gelatine. I do not know of any reagent that will do this. Peroxide of hydrogen, as described, appears to be excellent, the general idea being that it produces sodium sulphate and sulphuric acid

from the remaining hyposulphite, but this is a mistake. It produces no acid, and only about one-third of the sulphur is oxidised to sulphate. By mixing sodium hyposulphite with a large excess of the peroxide, and allowing them to remain together for three days, less than half the sulphur was changed to sulphate, and whatever change had been produced it was of little, if any, use, for the solution still gave a precipitate with mercuric chloride. Peroxide of hydrogen appears, therefore, to be of no avail; but, even if it were, it would be a very unsafe reagent in the hands of ordinary photographers, because its strength is very liable to decline. It may in a few months be only one-tenth of its original strength, and a bottle freshly opened, though originally without doubt of full strength, may be found to contain only a third of the stated quantity; and these changes lead to no alteration in the appearance of the liquid, and can only be recognised by a direct test. These uncertainties render it of very little use in the hands of those who are unable to estimate its strength. Alum and acids decompose sodium hyposulphite, but a mixture of alum and hydrochloric acid acts very slowly upon a weak solution of it, so slowly that one might be tempted to say that it also was useless. I find, however, that a fairly well washed negative is made more fit for intensification by treating it with an acid solution, or an acidified alum solution, and washing again, and I fancy that the improvement is not due merely to the extra washing that it gets. Whatever may be the actual change brought about by this treatment, I find that it is advantageous from a practical point of view, and that it is a desirable precaution to take.

DISCUSSION.

The CHAIRMAN said he hoped the discussion would do somewhat to remove Mr. Chapman Jones's impression that ordinary practitioners of photography worked entirely by rule of thumb.

Mr. J. CADETT said he thought what Mr. Chapman Jones had said was mainly correct, though amongst experienced workers there might, perhaps, be some difference of opinion as to the value of colouring matter in a negative. He had heard many photographers say that for a certain class of negatives they preferred a very yellow image to one in which practically no stain could be observed. Mr. Payne Jennings was very fond of yellow negatives, because practically the density was better without so much blocking in detail

of the high lights from what might be called lateral development. At his request he once developed a series of duplicate negatives with ferrous oxalate and pyro-ammonia, and compared them, and he was of opinion that the pyro-ammonia were much superior in crispness and brilliancy in the high lights. Of course, if such yellow stain was liable to alter in course of time, that was a disadvantage, but practical men often had to look to the value of the negative at the moment. Of course, this only applied to landscape work. With regard to portraiture, the necessity for the colour of the image to be the same as the grey of the retoucher's pencil was important, and would outweigh any advantage which a yellow image might have in landscape work. If he understood Mr. Jones aright, he said that the density of the image was practically altered by removing the stain, and from what he had seen of negatives printed, one that had a tendency to be thin on first production would certainly have been thinner in printing if a clearing solution were used. One must distinguish between the colour of the image and the mere stain in the gelatine film. He was quite sure, from his own experience, that Mr. Jones was right in all he said with regard to the stain when attached to the film itself, but when a clearing solution was poured on the negative there was sufficient change of colour to indicate that a reduction in intensity was obtained—at least, he thought so. He agreed with what was said about acid fixing baths; they certainly made the film hard, and presumably made the washing more difficult.

Mr. F. W. HART said it was many years since he had any practical experience in negative making, but with regard to ferrous oxalate, he used that 10 or 12 years ago for intensification, and found it of great value; but he did not use it quite in the manner described. He had a number of stained negatives brought him to treat by a gentleman who had been travelling about a good deal, and had not had a very abundant supply of water for washing, and he had endeavoured to intensify them with mercury and other things, the nature of which he did not know. After several experiments he assumed that the silver was all there which was originally deposited, and he wanted to get rid of all the mercury. He therefore treated the plates with chlorine water, and then exposed them to light and redeveloped with ferrous oxalate, and thus he got extra intensification. Then, after thoroughly washing, intensified again in the ordinary manner with mercury and ammonia. In this way he got the images much clearer and stronger than when they first came into his hands. Passing to the question of cleaning negatives, those gentlemen who were practising photography about 1864 must remember that about that time peroxide of hydrogen was introduced for the purpose of removing hyposulphite from paper prints. He had worked out that subject both with peroxide of hydrogen and with hypochlorous acid, and in his parallel ex-

periments he found, as Mr. Jones said, that the peroxide was not to be relied on, but that the hypochlorous acid was. He had continued to use that since 1864, and never had occasion to regret it. It would eliminate hyposulphites from prints and negatives, and was generally useful, if properly prepared, but was dangerous for any one to use haphazard; it must be used carefully and of proper strength. There was no question that it did turn hyposulphite into sulphate, and if any hyposulphite of silver were formed that must be converted into chloride of silver.

Mr. J. B. HANNAY said chemists had always been shy of using organic compounds as developers, and speaking generally ferrous oxalate was the only one which was safe. Most of his photographic experience was in the days of collodion, and even then good washing was essential, but with gelatine, which gave a much thicker film and had the substances clinging more perfectly to it, perfect washing was much more necessary. All processes of intensification depended on the simple principle that if you had a metal in process of precipitation that metal would precipitate wherever there was a similar metal. You therefore coated the image already formed with mercury, and then you had to remove the last traces of hyposulphite. Hydrogen peroxide was known to all chemists to be absolutely imperfect: if you added it to a hyposulphite oxidation did go on, but in a slower and slower ratio, until it stopped; but that was not the case with hypochlorous acid. No doubt organic compounds, such as amidol and hydroquinone, gave better graded results than inorganic developers such as iron salts; they were much more energetic reducers, and the result was generally a good deal better. Alum, it must be remembered, acted as an acid in many chemical reactions, as was seen in the manufacture of ultramarine. On the other hand, alumina was the best mordant known; all alum salts clung most tenaciously to gelatine, or any substance which would hold it, and it might be that it acted in this way in fixing the colouring matter into the plates.

Mr. CHAPMAN JONES, in reply, said he did not assert by any means that no photographers knew anything of chemistry, but there were about 4,000 professional photographers in England, and he could not say how many thousand amateurs, and he feared the proportion of them who knew anything about the sciences on which the art depended was very small. He had no doubt some preferred a yellow image, and he had given a reason for it. A plate poor in silver gave a better image if staining matter was mixed with it, because there was not enough silver to give a good image without it; or if there was under-exposure, or the plate was not sufficiently developed, the addition of the staining matter gave a denser and

better image, so that if one merely looked at the immediate use of the negative, and only used it for ordinary photographic purposes, there was something to be said in favour of the presence of staining matter. But you could never be sure that such a negative would not change; if you lightened the colour of the staining matter it was always liable to go back, and the staining matter might fade, so that you could never rely upon it. It was quite possible that Mr. Payne Jennings preferred a negative not strictly true in gradation; he might prefer one which had rather thinner shadows; and if he had an image of silver and staining matter, and washed away a part of the latter, he would get such a negative. But that was not a scientific way of doing it. Mr. Hart's observations about the action of chlorine water, followed by ferrous oxalate, he could not say much about, except that they were interesting. The point of his paper was rather to indicate how they could get chemically pure, clean, and reliable negatives. Hypochlorites did, of course, oxidise hyposulphites into sulphates rapidly, but he omitted them, because he had made the condition that the substance used for getting rid of the small residue of hyposulphite ought to be such as would not affect either the gelatine or the silver image. The hypochlorites would affect the silver image to a certain extent, and would affect the surface of the film and the image which lay on the surface probably to a greater extent than the image which lay below; so that the change, if it did not go right through the film, would be partial, and result in a greater proportional effect upon the shadows than upon the lights. A negative which had chloride of silver left in it could hardly be regarded as satisfactory. Hypochlorites, therefore, from his point of view, were not admissible, because it was difficult to prevent them having an erratic action. He could not quite follow what Mr. Hannay said with regard to the action of organic developers. They left a perfectly pure metallic image, if you avoided the production of staining matter. Metol solution, or amidol, or eikonogen, for example, properly mixed with sulphite, so as to get no stain, would leave a perfectly pure metallic residue when applied to an image after treatment with mercuric chloride, only you did not get all the mercury left, nor did you get a fixed proportion of the mercury; that was where the difficulty came in. Peroxide of hydrogen acted on the hyposulphites; he was not prepared to say what was produced, but one might say with probable certainty that one-third of the sulphur was oxidised to sulphate, and it appeared that the remainder was changed into a salt of one of the polythionic acids. Experiments on gradation, as produced by various developers, rather pointed to the idea that the gradation was the same in all cases, provided you were sufficiently careful to get regular and perfect images, free from staining matter.

The CHAIRMAN, in proposing a vote of thanks

to Mr. Jones, said this was a most important paper, from a photographic point of view; and they must all agree that the more scientific way was to know when they had a pure silver image on the plate. There was then something definite to work upon. The question of having a yellow stain or a brown stain must be left to the judgment of each individual worker; but, if you started with a pure silver image, you could get what you wanted with more certainty than in any other way.

The vote of thanks was carried unanimously, and the meeting adjourned.

Miscellaneous.

ART AND PHOTOGRAPHY.

Some very sensible observations, says the *Daily Graphic*, on the "Influence of Photography on Art, and of Art on Photography," were made by Mr. W. Yeames, R.A., at the Conference of the Camera Club, which was opened by Captain Abney, C.B., in the meeting-room of the Society of Arts on Monday, 23rd inst. The most instructive of them, perhaps, were those which dealt with the things which art and photography, in their relation to one another, ought to avoid—with the use which art should not make of photography, and the effects of art which photography should not emulate. With regard to the questionable uses to which some painters have lately put photography, the lecturer said:—"There is one direct use of photography which has been made use of by skilful painters—I mean that of having the landscape or figures or portrait taken from nature by the camera, reproduced by chemical means on the canvas, and painted over by the artist. However carefully the painter may try to conceal the underwork of photography, it somehow reveals itself, and the moment it occurs to us that what we are looking at is partly the work of the camera, we are seized with a decided repulsion to the picture. I presume, in a measure, it is the same feeling aroused in us on detecting a forgery, or against anything pretending to be what it is not." With regard to the second point, Mr. Yeames said, "We know that the particular fascination of a sketch lies in the fact that with a few rapid strokes and washes of the brush a strong and vivid impression is conveyed, this method being adopted by the artist to fix on paper or canvas passing effects, or the fleeting impressions on his mind of expressions and actions, and their attractiveness is due to the salient points of interest being indicated, the rest being left vague, and to the imagination. In a rapid sketch we may well say the painter has put in the whole vehemence of his feeling for the subject he is treating. Now in many photographs at the Artistic Photograph

Exhibition at the Dudley Gallery, this emphasising of some parts, and leaving others in the vague, was obtained in various ways, either by printing certain portions less than others, by printing them on coloured and rough paper, so as to obliterate detail, and obtain the smudginess of a sketch, and by other artificial means, all the while striving, as it were, to do away with the chief merit of photography—I mean precision, and that faithful rendering of every part that comes within the range of the lens. The camera has not the excuse of the artist that he had not time to do more, and what success he obtains is certainly unpremeditated; with one it has come naturally, with the other artificially. I presume that it is owing to this that these efforts of photography left a painful and unpleasant feeling on my mind; it was like a man putting on a coat that was not intended for him, and was consequently a misfit."

Correspondence.

INTERNAL LAND OR WATER TRANSIT.

General Sir ARTHUR COTTON, K. C. S. I., writes:—"The great question of internal land or water transit seems to have been at last settled by the Manchester Canal. The Lancashire capitalists, after trying land carriage for 60 years, spending £2,000,000 or £3,000,000 on it, have come to the conclusion that the cost of it is so intolerable that they have spent £14,000,000 on a canal of 35 miles (with docks), by the side of the railway; and there appears assurance of immense success from the first day of using it. The Lancashire men are not generally considered non-intelligent, but yet one might have supposed that they would have learnt such a lesson in less than 60 years. But now certainly nothing can stop the progress of water carriage in England till the four great rivers are united through Birmingham by effective ship canals, which would turn the scale in favour of a hundred works of mining and manufacture in their competition with foreign and colonial rivals. But if this is the case in England with its small lines of transit, how much more in India with its lines of ten times the length here. The Government have spent £200,000,000 in land lines there. If they would now learn a lesson from Lancashire, and spend only £20,000,000 on 5,000 miles of steam-boat canals, on main lines along the plains of the Indus and Ganges, round the coast of the peninsula, and across it, they would certainly add to the wealth of the country an annual sum much beyond the capital invested. On one single article of 1,000,000 tons of wheat the saving would be nearly £2,000,000 per annum, the cost of working would not be above 1¹/₂d. per ton and per passenger per mile, and any speed to suit such article or person could be used up to thirty land miles per hour, already attained in small vessels in England. This

certainly would not make up for the terrible mistake made in spending £12,000 a mile on lines of land transit in 16,000 miles, but it is the only thing that can now be done to set matters to rights in a measure.

General Notes.

WOODEN SPOONS.—The manufacture of wooden spoons in Russia occupies great attention, and is concentrated principally in the Semenovsk district in the government of Nishni-Novgorod; the chief material used is birch, and small quantities of poplar, maple, and palm, the latter being imported. In that district, this industry occupies 7,000 men. A load consisting of one-tenth of a cubic fathom of birchwood is sufficient for making 400 spoons, and one man can make 800 pieces per day; the total production attains the enormous figure of 12,000,000 spoons a year. The spoons are sold from 6 to 8 roubles (12s. to 14s.) per thousand. All the goods are sent to the village of Gorodets on the Volga, and thence to Nizhni and Isbit, penetrating as far as Persia, Khiva, Bokhara, and Khokand.

RECEIPTS OF PARIS THEATRES IN 1893.—A report has recently been issued showing the receipts of the various theatres and other places of public amusement in Paris in each of the years from 1850 to 1893 inclusive. In the latter year the amount realised was £1,125,284, as compared with £901,332 in 1892, and £943,986 in 1891. In the exhibition years of 1867, 1878, and 1889, the receipts were respectively £879,354, £1,226,299, and £1,285,559. In the disastrous years of 1870 and 1871, the amounts received were respectively, £324,291 and £228,604. It should be observed that last year was the first in which the Administration of Public Assistance included under the heading of theatres properly so-called, *cafés concerts*, and other similar establishments, which did not appear in previous years. In order, therefore, to render the total receipts of 1893 strictly comparable with preceding years, a deduction should be made of £263,113, the receipts from these establishments. Taking the amounts received from each establishment, it will be found that the opera heads the list with a sum equivalent to £132,783, the Comédie Française comes next with £73,595, the Opera Comique with £68,964, the Variétés with £46,452, the Folies Bergère with £45,144, the Vaudeville with £39,083, and the Nouveau Cirque with £37,858.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

MAY 2.—"Nickel." By A. G. CHARLETON, A.R.S.M. PROF. CLEMENT LE NEVE FOSTER Ph.D., F.R.S., will preside.

MAY 9.—“Telegraphs and Trade Routes in Persia.” By COLONEL WELLS.

Papers for which dates have not yet been fixed:—

“Reproduction of Colour by Photography.” By CAPTAIN W. DE W. ABNEY, C.B., F.R.S.

“Automatic Gem and Gold Separator.” By WILLIAM S. LOCKHART.

“Application of Electricity to the Disinfection of Sewage.” By MONS. HERMITE.

“Liquid Fuels.” By G. STOCKFLETH.

FOREIGN AND COLONIAL SECTION.

At Eight o'clock:—

MAY 29.—“Education in Victoria.” By Prof. C. H. PEARSON, M.A., LL.D.

APPLIED ART SECTION.

Tuesday Evenings, at Eight o'clock:—

MAY 8.—“Pewter.” By J. STARKIE GARDNER. PROF. W. C. ROBERTS-AUSTEN, C.B., F.R.S., will preside.

MAY 22.—“Decorative Art in connection with Elementary Education.” By SELWYN IMAGE, M.A.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

HENRY CHARLES JENKINS, A.M.Inst.C.E.
“Typewriting Machines.” Two Lectures.

LECTURE I.—APRIL 30.—Writing and Printing Machines—Machines at the 1851 Exhibition for the use of the Blind—Elementary Forms of Typewriters—Early attempts to construct Practical Machines by Hughes, Wheatstone, Foucault, Beach, and others.

LECTURE II.—MAY 7.—Requirements that a Type-writing Machine should meet—Later attempts to satisfy these—Type-bar and Type-wheel Machines—Keyboards and change of “Case”—Alignment—Supply of Ink to Type—Inspection of the Writing—Spacing of the Letters—Stenographic Machines.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 30.—SOCIETY OF ARTS, 8 p.m. (Cantor Lectures.) Mr. H. C. Jenkins, “Typewriting Machines.” (Lecture I.)

Farmers' Club, Salisbury-square Hotel, Fleet-street, E.C., 4 p.m. Dr. Voelcker, “The Woburn Feeding Experiments.”

Camera Club, Charing-cross-road, W.C. 8 p.m. Mr. J. Taylor, “Description of the Photo-Autocopyist.”

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. Harold Griffin, “Weekly Property as an Investment.”

Japan Society, 20, Hanover-square, W., 8½ p.m. Ven. Archdeacon Shaw, “Aspects of Social Life in Modern Japan.”

Actuaries, Staples-inn-hall, Holborn, 7 p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

Meteorological, Sanitary Institute, 74A, Margaret-street, W., 8½ p.m. Mr. R. H. Scott, “Barometric Conditions and Air Movements.”

Zoological, 3, Hanover-square, W., 4 p.m. Annual Meeting.

TUESDAY, MAY 1.—Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. W. Judd, “Rubies—their Nature, Origin, and Metamorphoses.” (Lecture I.)

Central Chamber of Agriculture at the House of THE SOCIETY OF ARTS, 11 a.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. William Colquhoun, “The Manufacture of Briquette Fuel.”

Pathological, 20, Hanover-square, W., 8½ p.m. Biblical Archaeology, 37, Great Russell-street, W.C., 8 p.m.

WEDNESDAY, MAY 2.—SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. A. G. Charleton, “Nickel.”

Iron and Steel Institute, 25, Great George-street, S.W., 10½ a.m. Annual Meeting. 1. Address by the President. 2. Reading of Papers and Discussion.

Archæological Association, 32, Sackville-st., W., 4½ p.m. Annual Meeting.

Obstetrical, 20, Hanover-square, W., 8 p.m.

Archæological Institution, Oxford-mansion, Oxford-street, W., 4 p.m.

THURSDAY, MAY 3.—Linnean, Burlington-house, W., 8 p.m. 1. Mr. H. B. Guppy, “Notes on the Habits of Certain Species of Lemna.” 2. Mr. H. N. Ridley, “The Fertilisation of Certain Malayan Orchids.”

Chemical, Burlington-house, W., 8 p.m. 1. Professor Smithells, “The Structure and Chemistry of the Cyanogen Flame.” 2. Mr. J. O. Arnold, “The Condition in which Carbon Exists in Steel.” 3. Dr. Kipping, “Hydindone and its Derivatives.” 4. Mr. J. B. Hannay, “Volatile Compounds of Lead Sulphide.”

Society for the Encouragement of Fine Arts, 9, Conduit-street, W. 8 p.m. Miss Zitella Tomkins, “Woman in Relation to High Art.”

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Dewar, “The Solid and Liquid States of Matter.”

Meteorological, Sanitary Institute, 74A, Margaret-street, W., 8½ p.m. Mr. W. Marriott, “Moisture—its Determination and Measurement.”

Iron and Steel Institute, 25, Great George-street, W., 10½ a.m. Annual Meeting. Papers and discussions continued.

Camera Club, Charing-cross-road, W.C., 8 p.m. Mr. H. Noel Cox, “Chicago Exposition.”

FRIDAY, MAY 4.—United Service Institution, Whitehall-yard, 3 p.m. Lieut. W. C. Crutchley, “National Methods for Securing a Supply of Seamen.”

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Prof. Charles Stewart, “Sound Production of the Lower Animals.”

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (“James Forrest” Lecture.) Dr. John Hopkinson, “The Relation of Mathematics to Engineering.”

Geologists' Association, University College, W.C., 8 p.m.

Philological, University College, W.C., 8 p.m. Annual Meeting.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, MAY 5.—Royal Institution, Albemarle-street, W., 3 p.m. (Tyndale Lecture.) Captain Abney, “Colour Vision.”

Journal of the Society of Arts.

No. 2,163. VOL. XLII.

FRIDAY, MAY 4, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CONVERSAZIONE.

The Society's *conversazione* is fixed to take place at the Imperial Institute, South Kensington (by permission of the Executive Council), on Friday evening, June 22.

Each member will receive a card for himself, which will not be transferable, and a card for a lady. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member.

Further particulars as to the arrangements will be given in future numbers of the *Journal*.

CANTOR LECTURES.

The first lecture of a course on "Typewriting Machines" was delivered by Mr. HENRY CHARLES JENKINS, A.M.Inst.C.E., on Monday evening, 30th April.

The lectures will be printed in the *Journal* during the summer recess.

Proceedings of the Society.

FOREIGN & COLONIAL SECTION.

Thursday, April 19, 1894; Sir ROBERT HERBERT, G.C.B., Agent-General for Tasmania, in the chair.

The paper read was—

TASMANIA AND THE FORTHCOMING HOBART INTERNATIONAL EXHIBITION 1894-95.

By G. COLLINS LEVEY, C.M.G.

It is my desire this evening rather to invite your attention to modern and industrial Tas-

mania than to dwell upon the discovery and settlement of the island, or the early struggles of the infant colony. But it is difficult to convey a faithful impression of the present condition of the smallest, but perhaps the most stable, of the Australian colonies without saying something about the intrepid men who first made the existence of the island known to the rest of the world.

Abel Jansz Tasman, a Dutch navigator, was the discoverer of Tasmania and New Zealand. In 1642 Anthony Van Diemen, Governor-General of Netherland East Indies, fitted out two ships, the *Zeehan* and *Heemskirk*, for the purpose of exploring the coast of Australia, which had been sighted by previous navigators, and gave the command to Tasman. Tradition is silent about the tonnage of the two vessels on board of which Tasman, with a light heart, sailed for the unknown Southern Seas, but the probability is that they were about the size of an ordinary sailing barge, and that the officers of the Board of Trade would in this latter decade of the nineteenth century condemn them as unseaworthy if it were sought to cross the North Sea in them from London to Rotterdam. As to the sufferings of the unfortunate crews from scurvy and the other maladies from which, at that distant date, seafaring humanity was scarcely ever exempt, history says nothing. Tasman sailed from Batavia, on August 16th, 1642, touched at Mauritius in October; sailed October 27th, and discovered land at Point Hibbs near Macquarie Harbour, in the neighbourhood of Mount Zeehan on November 24th. He anchored at Frederick Hendrik Bay, near Hobart, on December 1st, took possession of the country on behalf of Holland, and named it after his patron, Van Diemen. Tasman sighted Storm Bay, Maria Island, which he named after Governor Van Diemen's wife, and Tasman Peninsula, and sailed on December 8th easterly, the last point of Tasmania seen by him being St. Patrick's Head near the present terminus of the Fingal Railway. On December 13th he anchored near Cape Farewell, at the north-west of the Southern Island of New Zealand; the natives surrounded the vessels, upset a boat belonging to the *Zeehan*, and killed three men. Tasman thought it prudent not to avenge their deaths, and so he named the spot Murderers Bay, which has since been changed to Golden Bay. He sailed to the north, visited the west coast of the Northern Island as far as the Three Kings, named the Cape at the extreme north-west of the Northern Island Cape

Maria Van Diemen, a name which it still retains. Continuing to sail northward he touched at Cocos Island to obtain supplies, and returned to Batavia on June 16th, 1643, after an absence of ten months. In 1644 he started on another expedition with three ships, the *Limmen*, the *Zeemeuw*, and the *Brak*. In these he surveyed the Gulf of Carpentaria, and portions of New Guinea and North Australia. No traces are left of these discoveries, and Tasman does not seem to have known that Australia and New Guinea are separate islands. Nothing is known of his subsequent career, and the probability is that he never returned to his native village on the banks of the Zuyder Zee.

But the fame of Tasman's discoveries reached Europe, and the island was visited, in 1772, by Captain Marion du Fresne, a French navigator, who commanded the ships *Mascaron* and *Castries*. He, like Tasman, anchored in Frederick Hendrik Bay. In 1773, Captain Furneaux, of the British ship *Adventure*, discovered Adventure Bay, near Bruni Island, and sailed along the eastern coast of Tasmania on his way to New Zealand. The great circumnavigator, Captain Cook, accompanied by Captain Clarke, visited Tasmania during the year 1777, and the island was touched at by Bligh in 1788, and again in 1792, when that officer planted some fruit trees. But none of these navigators went to Tasmania with the intention of forming a settlement. The first people to entertain the idea of permanent colonisation in Tasmania were the French. The visit of Marion du Fresne was made during the reign of Louis XV., when the French Court and the French people were thinking of everything rather than of extending their territory. The unfortunate La Perouse, who made a voyage of discovery in 1785, during the reign of Louis XVI., and was lost on a reef in the Southern Seas, never went near Tasmania, but D'Entrecasteaux, who with the ships *Recherche* and *Esperance* was despatched in search of La Perouse in 1792, during the very height of the Reign of Terror, anchored in the channel between South Bruni Island and the mainland which now bears his name, and remained there for more than a month. He surveyed the various rivers and harbours in the vicinity, and returning again in 1793, completed his surveys, and explored Norfolk Bay, Frederick Hendrik Bay, and the Derwent, which he named the *Rivière du Nord*. Next year, in ignorance of what D'Entrecasteaux

had done, similar surveys were made by Lieut. John Hayes, of the Bombay Navy.

There is some reason to believe that notwithstanding the domestic troubles from which France at that period was suffering, the Government entertained the idea of forming a settlement in some part of Australia, as a sort of counterpoise to the penal colony which Great Britain had founded in 1788 at Port Jackson. Such, at any rate, was the opinion of the British officials in the colonies, and they did everything in their power to obtain as much information as possible about the vast continent on the fringe of which they were established, and to plant the British flag in every locality suitable for colonisation. In 1798, Governor Hunter despatched Bass in a whaleboat (in which men nowadays would not care to cross from Sheerness to Southend) to explore the coast to the south of Sydney, and this courageous man, with a crew of six boatmen, rowed through the storm-tossed straits which are named after him, and demonstrated that Tasmania was an island. The next year, accompanied by Flinders, who subsequently was the first to circumnavigate Australia, Bass sailed round Tasmania and examined its various harbours. Three years afterwards, in 1800, the French sent another expedition under Baudin, on board the *Géographe* and the *Naturaliste* to sail along the southern coast of New Holland and Tasmania. Baudin did his work very well so far as the latter was concerned, and made a complete survey of the whole coast-line of Tasmania, with the exception of so much of the west coast as lies between Cape Grim and Port Davey. It is more than probable that it was the knowledge of Baudin's survey that precipitated the colonisation of Tasmania by the Port Jackson officials, the more especially as there were grave doubts, since the discovery that Tasmania was an island, whether, according to the law of nations, it could be regarded as under the jurisdiction of the Governor of New South Wales.

It was in 1802 that Governor King despatched the *Cumberland*, a small schooner of 25 tons, under the command of Lieutenant Robbins, to Storm Bay, near the mouth of the Derwent, to fix upon some eligible site for settlement, and to hoist the British flag. Robbins did not carry out his instructions, but he took possession of King's Island in Bass's Straits, visited Port Phillip, and returned to Port Jackson. By this time the Home Government had become alive to the

wisdom of occupying Tasmania, but before the despatch authorising the formation of a settlement at Port Dalrymple, near the mouth of the Tamar, had reached Sydney, Governor King had commissioned Lieutenant John Bowen to act as commandant and superintendent of a settlement to be established on the Derwent, above the site of the present city of Hobart, and near Risdon Cove. He sailed from Sydney on August 31, 1803, with two ships, the *Lady Nelson* of 60 tons, and the British whaler *Albion*, 306 tons. Bowen's staff consisted of three officials besides himself, his military force was a lance-corporal and seven privates of the New South Wales Corps, and his working population consisted of six free men and twenty-five convicts. They took with them six months' provisions, and had ten head of cattle, fifty sheep and a few goats, pigs and fowls. A short time afterwards the population was increased by fifteen additional soldiers, and forty-two prisoners. But the settlement made no progress, and when Colonel David Collins, who had been appointed by Governor King to the charge of the Risdon settlement arrived on February 15, 1804, no land was in cultivation. Colonel Collins moved the camp from Risdon to Sullivan's Cove, near the site of the present city of Hobart, believing that the position was in every respect more desirable. From such small beginnings Tasmania arose. *Sic fortis Etruria crevit.*

It was at Risdon that the first collision took place between the British and the aborigines. It is impossible to decide at this period of time whether the whites or the blacks were the aggressors, for the accounts of the persons who were present at the fight vary materially, and no one ever took the trouble to inquire into the version of the aborigines. But this catastrophe, which resulted in the death of ten or a dozen blacks, was the prelude to a series of conflicts in which, although the lives of many Europeans were sacrificed, the aborigines generally got the worst of it. It is believed that their numbers were originally about 5,000, and for many years they were formidable antagonists, but they gradually dwindled away. In 1830 an attempt was made to drive all of them to one corner of the island, but it failed. In the following year the remains of the tribes, 203 in number, were persuaded to leave the mainland and settle in South Bruny Island, from which they were removed to islands in Bass's Straits. In 1842 there were only 44 aborigines left, and in 1854 they had dwindled

to 16. The last pure-blooded Tasmanian woman, Truganini, died in 1876 at the age of 76, and the last man, William Lanne, died in 1869, aged 34. In 1888 a grant of 300 acres of land was made to Fanny Smith, a half-caste, who was the last surviving descendant of the native races on the mainland of Tasmania. There are, however, a considerable number of persons with more or less aboriginal blood in the islands of Bass's Straits.

The fate of the Tasmanian aborigines constitutes a history in the chapter of British colonisation of which our nation has no great reason to be proud. But it is difficult to see what other result could have followed the emigration to Tasmania of a superior race. History teaches us that whenever a strong race comes into contact with a weak one, not physically, for the North American Indians and the Maoris are amongst the finest specimens of the human race, but one with less power of adapting itself to new surroundings, and assimilating the civilisation of the new comers, one of three things occurs: the aborigines are either exterminated, as has been the case in many parts of North America, in Tasmania, and is rapidly occurring all over Australasia and Polynesia, or they are enslaved, which is impossible in the case of a race of fierce and bloodthirsty hunters; or the two races amalgamate. This latter may appear to be the most satisfactory solution of the difficulty, and in the early days of Australian colonisation, the various Governments which were always most humane in their treatment of the aborigines, whatever may have been the attitude of individual settlers, did their utmost to encourage legal marriages between members of the two races. In one colony, South Australia, the union was encouraged by a grant of land being made to the white man for the benefit of his dark wife and their progeny. But such marriages were frowned upon by the public opinion of even the lowest class in the community, and the total number celebrated was very small. Irregular connections were much more frequent, and many of the quarrels between the settlers and the aborigines arose from this cause. But half-caste children were almost invariably put to death by the tribe, and those who escaped that fate and grew to maturity found themselves in a most unenviable position; they neither belonged to one race or the other. As a matter of fact, there are at the present moment only a comparatively small number of half-castes in any part of Australasia; and it

may be doubted whether, in the interest of the world at large, it is not better that the savage man should disappear altogether, just as the bison of the North American prairies has been supplanted by Durhams and Herefords, than that there should arise a race of half-breeds such as that which has been established in many portions of South America, by the inter-marriage of the Spanish conquistadores and their descendants with the South American Indians. But whatever may be the fate of aboriginal races brought into contact with Latins, their doom, when their country is colonised by the Teutonic and Celtic races, appears to be annihilation, and the process of extinction takes place quite as rapidly if the natives are treated with kindness and gentleness as if they are shot down like wild beasts. If they are encouraged to live among the whites they do not copy our virtues, but they acquire our vices and our diseases, and whiskey, small-pox, and measles are far more fatal than the bullet or the sabre. I recollect having a conversation with an American cavalry officer, who had for a long time been stationed in the far West, and had taken part in several Indian wars. He repeated to me a conversation he had had with a chief, to whom he pointed out the folly of waging war against the United States. "I know," replied the chief, "that my braves are no match for your troopers, and I know that my race is doomed. But we shall live longer if we keep on fighting with you than if we are at peace and drink your fire-water. Your soldiers are less to be dreaded than your traders." I have said that the British nation has no great reason to be proud of its treatment of the Tasmanian aborigines. But I feel sure that their fate was unavoidable.

After the arrival of Colonel Collins and the foundation of Hobart, settlement proceeded very rapidly. Port Dalrymple and the neighbourhood of Launceston were settled in 1804, and agriculture was attempted in several localities near Hobart, but for some years the inhabitants suffered great hardships, and in 1807 flour was sold at £200 per ton. Colonel Collins died in 1810, in which year the first newspaper was published. The island was visited, in 1812, by General Macquarie, the Governor of New South Wales, who laid out the city of Hobart and named the streets. The position of Lieutenant-Governor, under the Governor-in-Chief who resided at Sydney, was held from 1813 to 1817 by Colonel Davey, and by Colonel Sorell from 1817 to 1823. In 1818, a census was taken, which gave the population

of the island at 3,240. It was in that year that the first free settlers arrived, and the colony began to make real progress. Up to that time, whatever prosperity it may have enjoyed arose from the expenditure by the Government upon the penal establishments.

The rights of the aborigines to the lands over which they had hunted were never recognised in any portion of Australia, and the whole country was regarded as belonging to the Crown. The same theory was acted upon in Tasmania; but a new system was introduced as to the method by which the Crown granted these lands in fee simple to private individuals, and it worked so well, that it is somewhat surprising that it has not been more generally followed. In the earlier days of British colonisation the Sovereign and his ministers made free grants of land to persons who had interest at Court, or exercised political influence on behalf of the Government, without any stipulations whatever, and it was in this way that large estates were acquired in the North American colonies and in the West Indies. A similar policy was pursued in New South Wales, except that the grants were made on a smaller scale by the local governor, and in almost every instance were confined to persons resident in the colony. In Tasmania the grants were not made to the favourites of the local officials, but upon a well-defined system. Every free immigrant was endowed with a tract of land in proportion to the amount of capital he brought with him to the colony, an acre for every pound, and he was allowed to include in his estimate of his capital the passage money for himself and family, his furniture, his farming stock, and any live animals he brought. The result was that no men took up land unless they were possessed of some capital, and they were not compelled to part with a large portion of their means to pay for their land with the almost invariable result of being obliged to have recourse to the local banks and other financial institutions. When compared with what is termed the Wakefield system, under which the settler had to pay at least 20s. per acre for his land, or the modern system in Australia, under which persons with small means or no means at all are encouraged to take up much larger blocks of land than they have the means to work, I think the Tasmanian system possessed many advantages, and it might well be followed should the British Government colonise any tracts of land in Africa which are suitable for

agricultural settlement. It is perhaps as well to mention that every settler was allowed the services of a certain number of convicts, termed locally assigned servants, whom he fed and clothed in return for their labour, and thereby relieved the Government of the cost of their supervision and maintenance.

After the arrival of the free settlers, the population rapidly increased, and in 1821 the census gave the number of inhabitants as 7,400; the sheep at 128,468; cattle, 34,790; horses, 550; and 14,940 acres of land were under cultivation. Courts of justice were substituted in 1822 for the courts-martial previously in existence. In 1824 Colonel Arthur was appointed Governor, and in 1825 the colony commenced an independent existence.

In 1828, the Van Diemen's Land Company (sheep farming) commenced operations on a block of 250,000 acres in the north-west part of the island, which was conditionally granted to the company by charter, passed on 9th November, 1825. The country round Emu Bay and Circular Head was explored on behalf of the company this year, and an addition of 100,000 acres was made to the company's original grant. About this time, also, another company of capitalists was formed—the Van Diemen's Land Establishment—who received a grant of 40,000 acres of land in the Norfolk Plains District for agricultural and stock-breeding purposes, and large importations of improved breeds of horses, sheep, and cattle were made.

The next important event in the history of Tasmania was the settlement of Port Phillip and Portland Bay, now the colony of Victoria, from the northern portion of the island. The Messrs. Henty occupied the country around Portland Bay in 1834; and in 1835 John Batman was appointed by an association of settlers to report upon the general capabilities of Port Phillip as a grazing and agricultural district. He purchased 2,000,000 of acres of land from some wandering aborigines in exchange for a quantity of blankets, knives, looking glasses, beads, and scissors, and got them to sign a deed of conveyance, which had been prepared prior to his departure from Launceston. As might have been expected, the Sydney Government simply laughed at the transaction, and it was disallowed by the Colonial-office. But Batman's report attracted attention to the fertile lands on the northern shores of Bass's Strait.

Launceston had the honour of originating the two expeditions which first permanently

occupied Port Phillip. The first of these—Batman's party—made their headquarters at Indented Head; the second, organised by Mr. J. P. Fawcner, entered the Yarra on the 28th of August, 1835, and moored their vessel, the *Enterprise*, to the trees which grew on the banks of the river, where the great city of Melbourne now stands. A brisk trade was soon opened up between the two colonies, and a large migration of Tasmanians, with their flocks, herds, and implements, soon set in in favour of the newly-founded colony. Thus, the honour of founding the colony of Victoria is due to Tasmanian enterprise.

At this time the population had grown to 40,172, a considerable proportion of whom were convicts. Gold was discovered in Victoria in 1851, and this event gave a great impetus to the agitation which had commenced several years before for the abolition of transportation, which finally ceased in 1853, while Sir William Denison was governor, and during the same year representative government was introduced. Since that date all modern discoveries and improvements have been gradually introduced into Tasmania, which now boasts of railways, electric telegraphs, gas, electric lighting, telephones, and is connected with the rest of the world by a submarine cable from its northern coast to the mainland of Australia, near Cape Shanck, in Victoria. The name of the island was changed to Tasmania in 1856, the old appellation, Van Diemen's Land, being identified with the convict system.

Let us now direct our attention to the principal features of the island whose discovery and history have been so briefly described. Although so near to Australia, and possessing with a few additions the same flora and fauna, the aspect of the countries is entirely different. Australia possesses no lofty mountains, Mount Kosciusko, 7,308 feet, being the highest, and no large rivers, although the Murray, Darling, and Murrumbidgee are long and drain a large area of country. Tasmania on the other hand is mountainous, although no mountain is more than 5,000 feet high, and well watered, although no river is of great size. The island is about one-sixth smaller than Ireland, and a little larger than the island of Ceylon. Its length from Cape Grim to South Cape is 210 miles, its greatest breadth 200 miles, and its area about 24,330 square miles, or 15,571,500 acres, exclusive of islands belonging to the colony which cover an area o

1,206,500 acres, so that the total area is 26,215 square miles. Tasmania has been described as a beautiful well-watered island, rich in harbours and inlets, traversed by high mountain ranges, full of crags, glens and ravines of commanding appearance, the basaltic cliffs of some being several hundred feet in perpendicular height. Everywhere on the coast are good anchorages, and many excellent harbours. The interior combines the climate of Brittany or Cornwall, but without their humidity, the beauty of the Apennines, and the fertility of England. Mountain and valley, hill and dale, forests and pasture lands, afford a most pleasing variety. The island is in the form of a heart, and is situated between $40^{\circ} 40'$ S., and $43^{\circ} 38'$ S., about 150 miles S. of the colony of Victoria. Tasmania has over a hundred hills and mountains ranging in altitude from 1,000 to more than 5,000 feet. A mountain range, chiefly of trap or greenstone formation, traverses the centre of the island from south to north-west, and it was to the extensive and fertile valleys and gently undulating lands eastward of this range that early settlement was chiefly confined. The great range strikes west when within about fifty miles of Bass's Straits, bounding with its precipitous heights the magnificent agricultural lands of the north-west coast. The eastern and south-west coasts are distinguished by long and rugged mountain ridges of quartzose and granitic formation. The highest mountain on the island, Cradle Mountain, is 5,069 feet high. There are several extensive lakes situated on the high central table-land—natural reservoirs which are the sources of some of the chief rivers. The largest are the Great Lake, thirteen miles long, with a maximum width of eight miles—area, 28,000 acres; Lake Sorell or Crescent, 17,000 acres; Lake St. Clair, 10,000 acres; Lake Arthur and Echo, each about 8,000 acres. Tasmania is watered by numerous rivers, some of them of considerable size. In the south is the Derwent, on which stands the capital city of Hobart. The estuary of this river forms one of the finest harbours in the Southern Hemisphere. The Tamar, the chief river of the north, on which stands the town of Launceston, is next in importance. It is forty miles long, and formed by the confluence of two rivers, the North and South Esk. It is navigable for vessels of large tonnage. The Davey and Huon rivers in the south, the Pieman and Gordon in the west, are navigable streams. There are sixteen rivers discharging into Bass's Straits, nearly all of

which are navigable at their mouth for medium-sized craft and on the east coast are several river harbours for small vessels. There are fifty-five islands belonging to Tasmania. The Furneaux Group, at the east end of Bass's Straits, comprises an area of 513,000 acres, and includes Flinders Island, and Cape Barren Island, Clarke Island, Chappell Island, and Kent's Group.

The climate is salubrious—the death-rate 14·10 per thousand. Observations taken at Hobart give the average temperature of January, the hottest month, at 63° , although 100° has occasionally been registered, and of July, which is midwinter, at 45° . September, October, and November are spring months, at which time the weather is bright and clear, the mean temperature being 54° . December, January, and February are summer months, during which there is little rain—the mean temperature is 62° . March, April, and May are autumn months, generally the pleasantest season of the year; the medium temperature then is 55° . June, July, and August are winter months; the average temperature is 47° . The mean temperature of the year, as estimated from observations extending over 38 years, from 1841 to 1879, is about $55^{\circ} 10'$. The mean reading of the thermometer during 1888 was at Hobart $54^{\circ} 4'$, and at Launceston, $56^{\circ} 6'$. The mean at Oatlands, which is almost in the centre of the island, and 1,400 feet above the level of the sea, was $51^{\circ} 76'$, and at Circular Head 55° , Low Head, $55^{\circ} 8'$. The mean number of days on which rain fell in Hobart was 51, the prevailing direction of wind being north-west and south. During 1888 the mean reading of the barometer at Hobart was 29.925° . The rainfall for the twelve months ending December, 1888, was 18·45 inches. Snow rarely falls even so far south as Hobart, although Mount Wellington, which towers above it 4,166 feet, is frequently covered with snow, even during the summer months.

The native animals are for the most part of the same genera as those of the mainland, but the native hyæna and native devil are peculiar to Tasmania, and the waters around and in the interior of the island contain better fish than those found near and in the mainland. All descriptions of European domestic animals and game, as well as salmon and brown trout, have been introduced with success. The forest trees are the same as those found in Victoria, with the addition of the Huon pine, which is largely used for constructive purposes, and the

King William pine, which, owing to difficulty of access to its habitat, has not been largely employed.

Until a comparatively short time ago little or nothing was known of the western half of Tasmania, with the exception of the immediate neighbourhood of the sea and the larger rivers. The lake and mountain country was covered with forests, which rendered it almost valueless for agricultural and pastoral purposes, and except in the immediate neighbourhood of the navigable rivers—the Mersey, the Forth, and the Leven—the timber had no commercial value, and the land would not pay for clearing. The mineral wealth of this large district was not suspected, although coal of fair quality had been found between the Dee and the Mersey rivers in 1850, and gold was discovered near Fingal in the north-eastern district, and in some other localities in 1852. But the extraordinary richness of the Victorian goldfields eclipsed all other discoveries. Tasmania, by its proximity to them, was at once most wonderfully affected. All kinds of products reached fabulous prices, and were exported to Victoria in such quantities that the value of total exports in 1851 of £665,790, reached £1,509,883 in 1852, and £1,756,316 in 1853. Migration of population of all classes from Tasmania to Victoria at once set in in alarming numbers. In 1842 it is estimated that there were nearly 40,000 adult males in the colony; but such was the migration to the Victorian goldfields in 1852, 1853, and 1854, that the adult males left in the colony were less than 22,261.

For many years Tasmania was a country of grey beards and children; the young men and young women, of all classes, as soon as they had attained manhood or womanhood, crossed the straits and entered upon the wider life and the more brilliant prospects which first Victoria and subsequently New South Wales and Queensland opened out to them. But even in its darkest days the fine climate of Tasmania induced a large number of the well-to-do inhabitants of the mainland to spend their summer in the cool and exhilarating atmosphere of the island colony, and the physique of the Australians was constantly rejuvenated by a short residence in Tasmania.

Two circumstances combined to arrest the steady migration of the Tasmanians to the mainland of Australia. The first was the commencement of railways, which enabled produce to be conveyed to the outports at a reasonable rate; the second was the discovery of mineral wealth. In 1860, two expeditions

were appointed by the Government to prosecute and search for gold and valuable minerals; in 1868, the first sod of the Launceston and Deloraine Railway was turned by H.R.H. the Duke of Edinburgh, and in 1871 it was officially opened for traffic by Governor Ducane. From this comparatively small beginning grew the present system of Tasmanian railways, all of which, with the exception of the Emu Bay and Bischoff, 48 miles, and the Zeehan-Dundas Railways, $7\frac{1}{4}$ miles, are the property of the State. The main artery of communication is the Tasmanian Main Line Railway, 133 miles long, gauge 3 ft. 6 in., from Hobart to Launceston, built by a British company upon a guarantee of 5 per cent. per annum for thirty years, upon a capital of £650,000. The total cost of construction and equipment was £1,188,136. The Government of Tasmania purchased this line for £1,106,500, payable in $3\frac{1}{2}$ per cent. inscribed Tasmanian bonds. Between Hobart and Launceston there are fourteen intermediate stations, and the journey is performed in six hours. The Launceston and Western Railway, from Launceston to Deloraine, 45 miles, was originally built on a 5 ft. 3 in. gauge; but a third rail has now been laid down, adapting it to the 3 ft. 6 in. Tasmanian gauge. The line from Deloraine to the Mersey at Formby, 37 miles long, was opened in 1885, and is now extended to Ulverstone, 12 miles farther. The other branches are, from Launceston to Scottsdale, 46 miles; Parattah to Oatlands, 5 miles; Derwent Valley Railway (from Bridgewater to Glenora), 24 miles; Fingal Railway (Corners to Avoca), 24 miles; Brighton and Apsley, 26 miles; the Emu Bay and the Bischoff Railway (private), is 48 miles long; the Don Tramway, 13 miles; and the Elwick Railway (private), 1 mile; Sorell line, 14 miles; Strahan and Zeehan, 36 miles; Chudleigh to Deloraine, 12; total, including private lines, 488 miles. Contract surveys have been authorised for lines from Kimberley's Ford to Western Railway, Ulverstone to Emu Bay, Parattah to Tunnack, Antill Ponds to Cressy and Longford, Glenora to Ouse, Scottsdale to Upper Ringarooma. The total expenditure for construction upon all lines open, including the main line, was £3,689,372; the mileage, 488 miles; average cost per mile, £7,560. The gross revenue in 1892 was £195,297, and the working expenses £172,046. The rolling-stock was 45 locomotives and 1,028 other vehicles.

The leading productive industry of Tasmania is mining; sixteen years back there was little known, and less thought about it. In 1869 it was of such small importance that it was not even mentioned in the colonial statistics. In the following year an export of gold appeared—2,141 oz., valued at £7,475. In 1887, the export of gold was 37,252 oz.; in 1888, 39,617 oz.; in 1889, 32,232 oz.; in 1890, 23,107 oz.; in 1891, 39,203 oz.; and in 1892, 45,110 oz. In 20 years 673,543 ounces of gold have been exported, valued at £2,600,000. The second great industry is tin mining. In 1872, just 22 years ago, this metal was unknown to Tasmanian statistics; in 1873, four tons of tin ore were exported, valued at £220; from that period to the end of 1892, the exports of tin ore and smelted tin represented 60,281 tons, valued at £5,592,615; in 1891, the export was 3,174 tons, valued at £290,797. The principal gold-mining regions are contiguous to the east and west banks of the river Tamar, about 35 miles from the town of Launceston; but alluvial gold, which does not always find place in the statistics, has for twelve or fourteen years been continuously obtained in considerable quantities on the River Arthur and the west coast. The tin-mining districts are widely scattered. The first important discovery was in 1879, at the renowned Mount Bischoff, on the north-west coast; this mine has paid nearly two millions of money to its shareholders, and has paid much more than a million in the shape of labour, although the original capital was only £30,000. The north-eastern and eastern deposits were next discovered, and opened out an enormous stretch of rich alluvial stanniferous country; and on the extreme west coast lodes of tin-bearing ore have been opened by numerous companies, but, so far, without much practical result. Silver and bismuth have also been found; and the former, through the development of the Mount Zeehan and Mount Dundas fields, now promises to surpass in output both gold and tin. The total output of silver was valued, in 1888, at £5,838; 1889, £7,044; 1890, £26,487; 1891, £52,284; and 1892, £45,502. Total £207,155. The coal fields are extensive, but are not worked to any very great extent, and the output averages about 50,000 tons per annum. The grand total of mineral production was, in 1892, £518,390.

The mineral wealth of Tasmania is, however, only partially developed; and although persons who invest in Tasmanian mines have to run the risk which necessarily attaches to

mining in every part of the globe, there is perhaps no country in which the prospects are more satisfactory and encouraging than they are in the colony which I am now endeavouring to describe. The report of the Secretary of Mines, dated July 24th, 1893, contains the following important statement:—

“It is satisfactory to note that, notwithstanding the financial crisis through which the colony is passing, rendering it difficult to obtain money for the purchase of machinery or to employ labour for developing mining property, the mining industry of the country is not only holding its own, but during the year which has just closed has made a very substantial advance. The value of the output of minerals and metals has exceeded by £40,000 the output for the year 1891-2. Machinery to the value of £35,000 has been imported and erected, and progressive works such as tramways, shafts, and tunnels, with other works of development, have been carried on with much vigour in various parts of the colony, but notably so on the west coast. In all quarters there is evidence of steady improvement, and there is every reason for believing that at no distant date there will be a large and important increase in the mineral export of the colony.

“The disastrous fall in the price of silver will no doubt have the effect of closing down some of our lower grade mines; but there will remain many mines rich in lead, which, with the improved and more economical method of working now prevailing, will still be worked at a substantial profit.

“Recent developments at Mount Lyell give promise of most important results. Dr. Ed. Peters, jun., M.D., M.E., an eminent metallurgist of the highest repute, has lately spent some months at the mine. In his report just issued he estimates the quantity of ore in sight at 4,500,000 tons. His figures for the average value of this ore per ton of 2,240 lbs. are—Copper 4½ per cent.; silver, 3 ozs.; gold, 2½ dwt. This ore, he asserts, can be worked at a net profit of £1 10s. 5d. per ton. Dr. Peters concludes his report with the words, ‘I will only say, in conclusion, that in the past 20 years I have never seen a mining and metallurgical proposition that promises so certainly to be a great and enduring property as this.’ If the practical result comes within measureable distance of what is here foreshadowed, the impetus given to trade throughout the colony by the successful working of this one mine alone will be immense.

“Discoveries of gold in quartz and alluvial have been made at Bell Mount, some 24 miles north-east of Sheffield, which bid fair to be of considerable value. Extensive deposits of tin have been found at Roy’s Hill, Brookstead, and Ben Lomond, in good accessible country near Avoca, all of which are favourably reported upon by the Geological Surveyor. Other deposits have also been found at the Iris River, at North-East Dundas, and at Stanley River, on the

West Coast ; whilst the known deposits of wolfram near the Pieman Heads, and nickel at Hazlewood and near Dundas, are reported as valuable and likely to be profitably worked. An extensive bed of cannel coal has been discovered at Barn Bluff ; it is stated to be of good quality and of great value, but its locality is in, at present, difficult country. Other discoveries of various minerals and of minor importance have also been made."

The people of Tasmania anticipate that the results from Mount Lyell will at any rate equal those from Mount Bischoff. All that is required is capital to develop the mine and to construct a railway from the town of Strahan. The Geological Surveyor, Mr. Montgomery, has reported at length upon the mine, and from this document I make the following extract :—

"The property is situated on a ridge connecting Mount Owen with Mount Lyell, about 1,000 feet above sea level, and distant by road about 30 miles from the port of Strahan. The road is a fairly good but narrow cart-road for 23 miles, as far as Lynchford, and from here onwards is a sledge-track very steep in places. The mine is situated on the eastern slope of the range, being at the head of one of the branches of the Linda Creek, an affluent of the King River. The lowest adit and the battery are about 180 feet below the saddle over which the road from Strahan comes in, and the top of the outcrop is about 230 feet above the adit. A route for a railway is now being surveyed from Strahan to the mine, and I understand that it is intended, if found practicable, to bring it over the saddle to the mine itself.

"The mine was discovered in 1886, gold having been traced up to it from the Linda Valley. On section 14-86 an immense outcrop of hematite was found, and proved to contain gold : this got the name of "The Iron Blow." Up till 1890 it was worked with varying success as a gold mine, the stuff from the outcrop being crushed and amalgamated in an ordinary stamp battery. The workings soon disclosed the existence of a large mass of pyrites standing in close connection with the hematite, and as development proceeded it has become evident that this pyrites really constitutes the main body of the deposit. Analysis having shown it to contain copper, gold, and silver, it was recognised at last that the treatment most suitable for the ore would be the process of smelting for copper, by which all the contained valuable metals would be recovered."

The report of the Secretary of Mines concludes with the following paragraph, which is applicable to other mining countries besides Tasmania :—

"In conclusion, I submit that there is every warrant for asserting that the mining industry of the

colony is in a progressive condition, and it is in no way idle to predict that with the facilities which the anticipated new legislation will afford for ensuring that more attention shall be paid to *bonâ fide* mining than to scrip-broking and company-mongering, a great advance will be recorded at the end of the year upon which we are now entering."

That mining in Tasmania is on the whole profitable is shown by the dividends which in 1891-92 reached £144,195, and in 1892, £121,091.

The constitution of Tasmania resembles that of the other Australasian colonies, inasmuch as the Executive Government is responsible to the Legislature, which consists of a Legislative Council and a House of Assembly, which together are termed the Parliament of Tasmania. The Legislative Council is composed of 18 members, elected by all natural-born or naturalised subjects of the Crown, who possess either a freehold worth £20 a year or a leasehold of £80, all barristers or solicitors on roll of Supreme Court, medical practitioners duly qualified, and all subjects holding a commission or possessing a degree. Each member is elected for six years. The House of Assembly consists of thirty-six members, elected by owners or occupiers of property, or by adult males who are in the receipt of £60 per annum as income, and have continuously resided in Tasmania for twelve months. The Assembly is elected for three years. The Governor, Viscount Gormanston, is by virtue of his office Commander-in-Chief of the troops in the colony, and has a salary of £3,500 a year. He is aided by a cabinet of responsible ministers consisting of four members. The defence force consists of 2,106 volunteers, and there is constabulary consisting of 305 men.

The population was, in 1892, 153,144, the increase in ten years being 32,310, and there were 80,760 males to 72,574 females. On June 1st, 1889, the population consisted of 144,000, and the numbers belonging to the principal religious denominations were Anglican 78,058, Roman Catholics 32,504, Wesleyan Methodists, 10,566, Presbyterian 13,328, Independents, 5,788, and Jews 336. There are 16 superior schools or colleges in the colony, with an average attendance of 1,320 ; 240 public elementary schools, with 18,156 scholars on roll ; and 101 private schools, with 4,420 scholars. Education is compulsory. There were also 582 children attending ragged schools. Technical schools were started in 1888 at Hobart and Launceston, and technical

teaching is now extended to other localities. The higher education is under the University of Tasmania, which holds examinations and grants degrees. Elementary education is under the control of a director, working under a ministerial head. There are several valuable scholarships from the lower to the higher schools, and from the higher schools to English universities. The total cost to Government of education in 1892 was £42,745. There are 33 public libraries and mechanics' institutes, with 66,000 volumes. There are five daily, four weekly, and four monthly journals.

The revenue for 1892 was £787,764, and the expenditure £919,801. The total amount raised by taxation was £438,136, the rest of the revenue being derived from railways, post and telegraphs, and the rent and sale of Crown lands. The public debt, December 31, 1892, amounted to £7,399,000, or £48 6s. 2d. per head of the population, which is lower per head than Queensland, South Australia, or New Zealand. The money raised by loans has been expended upon railways, £3,639,491; telegraphs, £113,803; roads, bridges, jetties, and harbours, £1,924,006; public buildings, £623,823; defences, £120,733; and other public works, £683,561. The net sum received on account of the taxes was £7,105,417. The expenditure on the public debt is £308,108 per annum. The principal assets of the Government are the railways, which have cost about 51·23 of the whole public debt, and 12,100,000 acres of Crown land. Since the commencement of the present year the public debt has been increased by £1,000,000 sterling, and in 1893 the revenue was insufficient to meet the expenditure by nearly £130,000.

The various municipalities have incurred debts to the amount of £409,132, upon which the interest paid is £16,365 per annum. The total area of the colony is 16,778,000 acres. At the end of 1892, 24,337 persons were directly engaged in agriculture. Of the total area, 4,647,988 acres have been sold or granted to settlers by the Crown, while 630,482 acres have been leased as sheep-runs. In 1892-3, the area under cultivation and permanent grass was 535,433 acres, of which 179,396 acres were under crop, and 356,037 under grasses; wheat occupied 58,897, produce 1,018,550 bushels; oats, 22,976, produce 631,746 bushels; potatoes, 16,535 acres, produce 60,245 tons; hay, 46,070 acres, produce 53,544 tons. Under the head of horticulture 536 acres were sown with hops, yielding 685,031 lbs. of hops. The yield of apples was

503,013 bushels. Fruit culture is of great importance; large quantities of fruit are exported. There were in the colony 31,976 horses, 135,072 head of cattle, 1,623,338 sheep, and 59,267 pigs. No figures are available for the earlier years as regards dairy farming, but in the seven years ending March, 1893, there has been an increase of 6,508 milch cows, or 22·83 per cent. and the dairy produce for 1893 was valued at £350,130. Tasmania, like Victoria, will become one of the great sources of the butter supply for the United Kingdom.

The imports, of late years, have considerably declined, and at the present moment the exports largely increase the exports. In 1890, the imports were £1,897,512, exports, £1,486,992; in 1891, the imports were £1,908,917, and the exports £1,206,921; in 1892, imports, £1,404,536, exports £1,179,279; 1893, imports £877,491, exports, £1,184,566. The principal exports, in 1892, were wool, £329,585; tin, £290,794; gold, £145,737; fruit, £147,886; silver and lead, £82,647; oats, £30,074; potatoes, £55,486; hides and skins, £44,019; bark, £38,212; and timber, £32,736. About 42·41 per cent. of the importation is by way of Victoria, and 36·18 with the United Kingdom. Of the export trade 40·04 per cent. is with Victoria, 32·54 with New South Wales, and 23·45 with the United Kingdom.

Tasmania is well provided with main roads. The telegraph system belongs to the Government. At the end of 1892 there were 1,856 miles open, 236 stations, and 319,334 messages were sent. There are 382 miles of telephone wire, with exchanges at New Norfolk, Hobart, and Launceston. The revenue from telegrams was £14,494. Newspaper packets and post-cards carried in 1892 was 11,968,346, the revenue £54,736, and the expenditure on posts and telegraphs £84,471, so that the whole service was carried on at a loss of about £15,500 per annum.

It would be impossible to deny that Tasmania, like all its neighbours on the mainland of Australia, is suffering a recovery. The decline in the price of silver prevented the development of the Zeehan and Dundas mines, and Tasmania has felt very severely the low value of all descriptions of agricultural and mineral produce. But a reaction has already commenced, and there is every reason to look forward to a long era of prosperity. Tasmania has within her comparatively limited area an infinite number of resources. She has great mineral wealth, a large area of fertile land well adapted for agriculture, and better

suited for dairying and fruit growing than any other part of Australia. And the difference in the seasons—the summer of the southern hemisphere being the winter of the northern—enables the dairymen to supply Great Britain with grass-grown butter at the very season when it is almost impossible to procure it from any portion of the northern hemisphere; and the same is the case with apples and pears, which arrive in London at the period when the European and American varieties are becoming tasteless from having been kept over from the previous autumn.

Tasmania has many resources which are denied to the mainland of Australia. Her unrivalled climate, the beauty of her scenery, and her proximity to Melbourne, which can easily be reached by railway from all parts of Victoria, New South Wales, South Australia, and Southern Queensland, has made her the Switzerland of Australia, with the additional advantage that she can be visited from the centres of population in the mainland far more easily than the Engadine, the Bernese Oberland, or Lucerne can be reached from London or Berlin. The Swiss farmer, trader, or inn-keeper is careless about the harvest or vintage, so long as the "tourist crop" is good, and Switzerland is invaded by the usual number of travellers, with well-lined purses, from all the cities of Europe. Tasmania is beginning to be enriched in a precisely similar manner, and there are few well-to-do families in the southern portions of Australia who do not make arrangements to spend some portion of the summer in the health-giving valleys, the breezy uplands, or on the picturesque mountain sides of Tasmania; and the same causes induce a large residential population of persons of moderate means, retired officers—civil and military, from India—and pensioned Civil servants from all parts of Australia. Life is cheap and agreeable, society is good, cultured, and refined, without extravagance or ostentation, and the educational advantages are, at least, equal to those of any other portion of Australia.

There are three great sources of wealth which up to the present are undeveloped. Considerable quantities of black wood and Huon pine have been exported to Australia, and the hard wood of Tasmania has been largely employed in building houses, jetties, and wharves in Victoria and New South Wales. But there is no reason why the highly-ornamental woods—the black wood, and Huon and King William pines, the myrtle, and the

musk—might not be largely employed in this country for furniture, or why the hard woods, such as the red gum and the box, should not be employed for street paving.

There is another great industry which is to-day altogether neglected. There is no country in the world whose waters are better supplied with fish, and as the seas are much colder, the finny inhabitants are far superior in flavour to those which are found in the ocean currents which wash the shores of the Australian mainland. The trumpeter, trevally, rock-cod, and king-fish are equal to the best fish found in the northern hemisphere; the flounder is a formidable rival to the sole, and the cray-fish to the lobster. If the fisheries were properly developed, they might not only furnish the people of Tasmania with a wholesome and nutritious food, but they might establish a lucrative trade with the mainland. The Tasmanians are beginning to realise that fresh butter will preserve its flavour for the whole time occupied on a voyage to England, but they have not yet learned that fish can be packed in ice and shipped to Melbourne Sydney, and Adelaide without any perceptible deterioration. The salmon-trout and the trout are now thoroughly established in the Tasmanian waters, as may be seen by anyone who will take the trouble to visit the Tasmanian Court at the Imperial Institute. But no properly organised attempt has yet been made to secure the harvest with which the Tasmanian shores abound.

Another industry, which in the early days of the colony afforded employment to a large section of the population and constituted a considerable proportion of its exports, was the whale fishery. For many years shore whaling was carried on at many portions of Tasmania, and at Encounter and Portland Bays on the mainland; the pursuit was exciting, profitable, and popular. Deep-sea whaling was carried on very extensively. In 1838 the produce of the fisheries was valued at £137,000. In 1848, 38 whalers sailed from Hobart; they had a tonnage of 7,260 tons, were manned by 1,100 men, and were valued at £148,000. The exports of sperm and black oil amounted to about £75,000 a year. But the discovery of gold in 1851, the migration of the adult males to the gold-fields of Victoria and New South Wales, and the large increase in wages, prevented the further development of whaling, and finally destroyed the industry altogether. In 1862, the exports of sperm and black oil were valued at £59,210; in 1872, at

£47,574; in 1877, £33,507; in 1882, £13,170; and in 1886 at only £9,463.

It is the fashion to assert that whale fishing is a thing of the past, that the whale is becoming extinct, and that the industry declined in Tasmania for the same reason that the Nantucket and New Bedford fishermen have abandoned the trade, or, in other words, that it did not pay. But I have not been able to find any evidence for this assertion. The Tasmanian whale fishery was killed by the discovery of gold, the difficulty of inducing men to lead the hard life of a whaler, and the high wages that had to be paid. Now that wages are lower, while the price of whale-bone has made it an almost unattainable luxury, there is every reason to believe that whaling might be re-introduced, with great profit and advantage. A number of ships from Dundee visited the southern ocean in 1892-93, and vessels from Scotland and Sweden were fishing for whales and seals last January in the Antarctic Ocean. An expert has made a calculation which shows that the business can be conducted at a large profit, and if it can be made to pay from Dundee and Stockholm, there is no reason why Hobart, which is in the very centre of the cruising grounds, should not enjoy the lion's share of the trade. The old whaling ground of Tasmania has had comparative rest for many years, and steam whalers fishing amongst the ice floes, and along the margin of the Antarctic ice fields would reach a ground which no sailing vessel had ever been able to touch.

An account of Tasmania would be incomplete without some reference to the Exhibition. About 12 months ago a number of enterprising people induced the Government of Tasmania to give its patronage to an Exhibition which is to be held at Hobart next November, and to remain open for six months, during the Australian summer, and at a time when Hobart is crowded with visitors who visit the island capital to avoid the torrid heats of the mainland used as the headquarters of the Australian fleet. The idea caught on, the scheme has been warmly supported in the Australian Colonies, a handsome building in the centre of the Queen's Domain, and near the Battery and the Central Railway Station has been erected, which with its annexes will cover eleven acres. The proposal has met with great support all over the world, especially in the United States and Canada. The British Government has decided to ask the Queen to appoint a Royal Commission, composed

of distinguished personages, under the presidency of the Marquis of Ripon, and a large number of British and Irish manufacturers have signified their intention of taking part in the Exhibition. Nor have the various foreign nations been at all backward in taking advantage of the opening which this Exhibition will afford for obtaining a portion of the lucrative commerce which Great Britain at the present time enjoys with her Australasian dependencies. Our manufacturing rivals fully realise that the Hobart Exhibition will be visited by nearly all the large consumers of imported produce, and the purchasers of imported luxuries that are to be found in Australia, and France, Belgium, Germany, Austria, and Switzerland will be largely represented on the banks of the Derwent next November. I can only trust that in the peaceful contest for the trade of Australia, victory may alight upon the banners of our own country.

Tasmania is easily reached from all parts of Europe and especially from Great Britain. Frequent steamers connect Launceston and Hobart with Melbourne and Sydney; the passage from Melbourne to Launceston does not occupy more than eighteen hours, of which at least ten are in smooth water, and the fares are remarkably low, the return tickets in the first class being £1 15s. in the winter and £2 10s. in the summer. The passage from Hobart to Melbourne occupies about thirty hours, the return tickets being £4. The Victorian capital can be reached from Great Britain and Italy by the Peninsular and Oriental, the Orient, and several other lines of first-class steamers, from France by the Messageries Maritimes, and from Germany, Belgium, and Italy by the North German Lloyd. The most direct way of reaching Tasmania is by the steamers of the New Zealand Shipping Company, the Shaw Savill, and Albion and other lines which, sailing from Great Britain for New Zealand, make Hobart a port of call. On the homeward passage these steamers do not return to Hobart, but sail to Great Britain *via* Cape Horn and Rio de Janeiro. Any traveller desirous to visit the magnificent scenery of New Zealand could break his journey at Hobart, and resume his voyage after a tour through Tasmania, and should he so desire, a trip across the Straits to Melbourne, Adelaide, Sydney, or Brisbane.

I have no desire to touch upon politics, or to discuss the vexed question of imperial or Australian federation. But most men pretending to any knowledge of statescraft entertain a

strong opinion that the connection between the various Australian colonies will become closer in the future than it has been in the past, that the centrifugal force which split the vast country over which the Governor of New South Wales originally had jurisdiction into half-a-dozen colonies has now spent itself, and that a strong centripetal movement will succeed it. In that case Tasmania will exercise a much greater influence over Australia than she has enjoyed up to the present. Continents have always been, to a large extent, dominated by islands. The Isles of Greece played a part in the destiny of the world, altogether disproportioned to their size and population. The wealth and influence of Great Britain are not to be measured by her acreage. And in the case of Tasmania she will have the additional advantage of the most invigorating climate which can be found throughout Australasia, except in the southern island of New Zealand, which is, perhaps, geographically too far removed from the Australian continent to modify its destinies. Hobart has been the city selected for the meetings of the Federal Council, and it is more than probable that it will be the capital of a Federated Australia. The day may come when the policy of the whole of Australasia is directed from Hobart, and it is possible, if ever the prophecies of Sir George Grey are carried out, that the great Anglo-Saxon-Celtic Council may sit there in regular sequence after London and Washington, that the naval and military defence of the empire will be decided there, and that in the words of Wentworth :—

Will Australasia float with flag unfurl'd
A new Britannia in another world!

DISCUSSION.

Sir JAS. A. YOUL, K.C.M.G., said he spent twenty-five of the pleasantest years of his life in Tasmania, and he could safely say that Mr. Levey had not in any way magnified either the beauties or the resources of that country. It had been a great pleasure to him to see the views of the places where he had lived so long and gained so much health, for whilst he was in poor health when he went there—he was now over 80 years of age—he attributed his good health entirely to the climate of Tasmania. Not only so, but it had given him the means of coming home to England to educate his children and of starting them in life in that colony. He had three sons now married, living on the banks of the South Esk river, one of the most beautiful streams in the world. Unfortunately, things had been so depressed lately, especially the price of wool, that they were

not as successful as he had been, in the farms he had given them; but a very little change of the price of wool would put things all right again. Twice in his life out there great depressions had occurred, though not through any financial crisis, but the price of all products was so low that it was impossible to sell anything; sheep were at 1s. 6d. a head, and other things in proportion, and it was very difficult to get money at all. A number of the leading colonists then agreed, in order to set a good example, that they would give up every possible luxury—wine, beer, and everything they could do without—and that had a very beneficial effect, at any rate on their own purses. When he first arrived in Tasmania, the only coin in circulation was the pillar dollar, which passed as five shillings, but it was so much in request by merchants trading to China, to buy tea, and to the sugar countries, that they collected all they could get and shipped them away. To prevent this, Governor Macquarie had a piece cut out of the centre of every dollar the Government could lay hands on. The piece of silver so cut out was called a dump, and its current value was 1s. 6d.; the only other currency were handfuls of 3d., 4d., and 6d. I.O.U.'s. He recollected on one occasion driving into Launceston, some 18 miles, on a wet day, with a very old hat on, and meeting some friends in the principal street, they said he must have a very good balance at his bankers, or he would not dare to come into town with such a hat. At that time there appeared no more chance of the circumstances of the colony recovering than at present, but in a few years those persons who had bought sheep at 1s. 6d. made fortunes. Wool got up from 8d. to 1s. 6d. a lb., and farmers soon got rich. A second time there was a depression, though not so severe. He rather thought the climate must have changed somewhat since he was there. He went out at the age of 16 or 17 to his father, the chaplain of the forces, who, unfortunately, died soon afterwards, leaving him, as the eldest of nine, to bring up his brothers and sisters. In those days he never recollected anyone being ill or taking physic; but since he left, he had heard of their having all the same complaints that we had in England. He hoped the prosperity, which continued for the most part while he was there, would soon return. They had been rather extravagant in borrowing money and making railways which did not pay, and if remonstrated with, they said, "Oh, their national debt was nothing to that of England." When they said that to him, he replied that in England the money was borrowed from Englishmen, and the interest went into their pockets, so that the money never left the island; but in Tasmania they had to send it away. He thought it a very fortunate thing that their credit had sunk, so that they could not borrow any more. He was very grateful to Mr. Levey for his paper, which, he hoped, would have a good effect in Tasmania.

The CHAIRMAN said he ought to have reminded

those not familiar with the matter that the introduction of salmon and trout into the Antipodes was due to the persistent efforts of Sir James Youl. With regard to the supposed change in the climatic conditions, he would suggest that possibly that mysterious malady, influenza, might have something to do with any increased amount of sickness that might have occurred in Tasmania, as well as elsewhere, and when that had passed away, as no doubt it would, Tasmania would recover its former high reputation as a sanatorium.

Sir FREDERICK YOUNG, K.C.M.G., said Mr. Levey had brought forward so much historical information with regard to the beautiful island of Tasmania, and had given such a vivid account of its resources and advantages, that every one must have listened to his paper with the greatest possible pleasure. He had not had the advantage of visiting Tasmania, though in the early years, to which Sir J. Youl had referred, he was very strongly imbued with the idea by Mr. Edward Gibbon Wakefield, that the climate of that country was the finest in the world, and that female beauty flourished there in a way that no other part of the world could match. He always felt that if fate had so ordained it that he should leave his native country, in order to settle in one of our colonies, it would have been to go to Tasmania. At the end of the paper Mr. Levey had touched on a very important political question, Imperial Federation, in which he himself had long taken a leading part and a deep interest; and though that was not the time to discuss it, his hopes were in accordance with what had been hinted at, and he trusted that some day an even closer political union might be established between the mother country and the colonies, including Tasmania.

Mr. A. P. BAKER said he had not had the pleasure of visiting Tasmania, but he might say a word or two with regard to the coming Exhibition, being an old exhibitor, and general manager of the British and Colonial Exhibition to be opened in Manchester in the autumn. It was very important that British manufactures should be introduced into the colonies, in order that foreigners should not have it all their own way, and there was no better method than exhibitions. He had always found it pay very well to go to exhibitions; he did very well at the Jamaica Exhibition in 1890-91, and so did most of the exhibitors, those from Canada especially. It was also very important that colonial produce should be introduced to England, and that was what he was endeavouring to bring about at Manchester. Exhibitors should either attend themselves or send someone thoroughly up to the business, otherwise their efforts were to a great extent thrown away. If you had a good article, there was no better means of making it known than an exhibition. Advertising was all very well for articles that were not thoroughly good, but if they were it was much better to let them be seen.

He believed exhibitions were as yet in their infancy, and he hoped there would be a jubilee in 1901.

Mr. TREEVE EDGCOMBE said last year Australia suffered from a very severe banking crisis, and he should like to ask Mr. Levey to what he attributed the singular immunity which Tasmania enjoyed from such disasters. Was this not one other instance of the prosperity of Tasmania, which, *inter alia*, might have been included in Mr. Levey's glowing description of the colony?

Mr. LEVEY, in reply, said Sir J. Youl was no doubt perfectly right in saying that the national debt of England was practically all held by Englishmen, and that the interest was only taken out of one pocket and put into another; but there was another point of view which was quite as important. The national debt of Tasmania had been almost entirely spent in remunerative public works, whilst that of England was spent in foreign wars, the net result of which was to add considerably to her territory, but not much, perhaps, to her available wealth. In Tasmania, 52 per cent. of the debt had been spent on railways, and 27 or 28 per cent. on harbours, jetties, and works of that kind, and if she were to sell those public properties for what they cost the remaining debt would not be very large. No doubt the railways were somewhat in advance of the present requirements of the country in certain localities, but they were not in advance of what they would be at the end of the century if the population went on increasing at the present rate; and then the working expenses would not be so high. He could not help thinking that the step recently taken of bringing over from New South Wales a railway expert would have the effect of much increasing the returns and reducing the expenses. With regard to Mr. Edgcome's question, he felt great delicacy in saying anything as to the causes of financial changes, especially after the terrible results which followed the remarks made in a very guarded manner by Mr. Peel. He might say, however, that there were two causes for the crisis. There was the *causa causans* and the *causa sine qua non*. Firstly, the depression in Australia had arisen, as it had everywhere except in countries which had an enormous reserve of wealth, by the great fall in the value of all kinds of produce. When wool, the great staple export, fell to something like one-half, silver to nearly one-half, wheat quite one-half, that caused a terrible depression. This was enhanced in New South Wales by land speculation, in Victoria by a very unusual amount of land speculation, and in Queensland by a very large increase in settlement and development of country. The interior of Queensland had been very largely developed, the banks had made large advances to the settlers, and when the depreciation of values set in, this aggravated the mischief. In South Australia, where the progress was not so rapid, there was no banking crisis;

in New Zealand and Western Australia there was none, and in Tasmania there was none, because there had been no very great increase in the development of the country, or any great extension of credit.

Mr. McMURRAY said he should not like the meeting to close without saying a word or two, having been 43 years in the colonies; 16 in Tasmania. Mr. Levey had done full justice to the beauties of the colony and the climate, but it could hardly be said that there had been no banking crisis, because there was the failure of the Bank of Van Diemen's Land, but if things had gone on rightly, and no feeling had been imported into the banking business, that bank never would have closed. As it was, they divided about 12s. in the pound, and there were about £300,000 of assets still available. He was very pleased to see that the people of London took some interest in Tasmania. Rightly or wrongly, it had the reputation of being a kind of Sleepy Hollow, and perhaps to some slight extent that was true. A few years ago, when Sir George Strahan was Governor, in addressing a meeting, he told them how he went into a shop in Edinburgh and asked for a chart of Tasmania, and the person in charge did not even know where it was, and asked what interest he had in Tasmania; he said, "I am slightly interested, seeing I am appointed Governor." This was his first visit to the old country since 1852, so that he had seen a good deal of the ups and downs of the colonies. It was quite true, as Mr. Levey said, that they must look to mining to bring Tasmania to the front. More men were occupied on one mining lease than were engaged in sheep farming in the whole distance of 50 miles from Kanara up to St. Mary's; in fact, the very existence of Tasmania depended on her mineral resources. No one could doubt the extent of those resources; for instance, the Mount Bischoff Company had undergone the same experience as Broken Hill and Mount Morgan. The shares were issued at £1, and if a man took 100, he had another 100 preference, so that in reality they cost 10s. a share, and now that mine had paid in dividends over £1,600,000. There were other large mines which would come to the front, one of which was Mount Lyell. Unfortunately for English capitalists, they did not take it up, but since it was withdrawn from the market they had been raising 2,000 and 3,000 ozs. of silver to the ton, and they had now made up their minds they would do themselves all the dead work they wanted English capitalists to do. Mount Reid was another, and Mount Zechariah was also developing well. Like all other new speculations, there was a boom at first and then a rush back. When people made up their minds to go into the mines, instead of into the market, things would soon improve. He thought there were four reasons why Victoria had suffered so much from depression. In 1888, there was a big boom in connection with Broken Hill, and shares went up to £400 or £500, and then they came back

to £150. That share was one of 16,000, which cost £9 originally, in Melbourne market, and rose to be worth over £500,000. That was one reason for the depression in Melbourne. Another thing was the land boom, when the land in Collins-street rose to a higher value than in many of the principal streets in London. He knew of land being sold in that street for close on £3,000 per foot frontage. Then, of course, there was a reaction. The next boom was the investment boom. People got afraid of land, and went into banking and other shares, and that was overdone. Tramway shares went up to nearly £10, which were now worth 10s. But the heaviest blow Melbourne received, in his opinion, was the strike. There was no wonder when Melbourne suffered so much that New South Wales and Queensland should suffer a little. But there was so much vitality in these colonies that though they were a little in the background at present, in a very few years they would come to the front again, more especially the youngest one, Western Australia. Twenty years ago he went there in the hope of finding gold, which he did not, but he found lead and copper. He had seen wonderfully rich quartz at various times, but never anything so rich in his life as some that came from Western Australia. The reports he had from one claim were really astounding. Western Australia would benefit by this in the first place, but the other colonies would all share in the advantage.

The CHAIRMAN said the paper was so interesting and suggestive, that no doubt they could go on for some hours discussing the various points it opened up, but as time was getting on he would pass over his own notes, some of which had been anticipated by other speakers, and simply propose a hearty vote of thanks to Mr. Levey, whom he hoped they would have the privilege of hearing again on some future occasion, for his able and very interesting paper.

The vote of thanks having been carried unanimously,

Mr. LEVEY, in responding, said he agreed with a good deal which had been said by Mr. McMurray. He was quite sure the recuperative energy of a new country, like that of a young man, would soon bring Australia to the front again. It was only a question of a very few months.

INDIAN SECTION.

Thursday, April 26; Sir STEUART BAYLEY, K.C.S.I., C.I.E., in the chair. The paper read was "Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh," by Sir AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E.

The paper and discussion will be printed in the next number of the *Journal*.

TWENTIETH ORDINARY MEETING.

Wednesday, May 2, 1894; Professor CLEMENT LE NEVE FOSTER, D.Sc., F.R.S., Member of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Craster, Major-General George Ayton, United Service Club, Pall Mall, S.W.

Field, John W., Gas Light and Coke Company, Horseferry-road, Westminster, S.W.

Holland, Honourable Lionel, 58, Conduit-street, W. Le Mesurier, Lieut.-Colonel Thomas Augustus, 2, Gloucester-walk, Kensington, W.

Mills, William Frederick, 24, Soho-square, W.

Wasey, George Kindersley, West of India Portuguese Guaranteed Railway Company, Morumgão, Goa, India.

The following candidates were balloted for and duly elected members of the Society:—

Franklin, George Edward, Rickmansworth, Herts.

Krall, Carl, 289 and 291, Regent-street, W.

Osborne, James, 30, St. Swithin's-lane, E.C.

Toleman, Richard James, 17, Goswell-road, E.C.

The paper read was—

NICKEL: ITS HISTORY, USES, AND DISTRIBUTION.

BY A. G. CHARLETON, A.R.S.M.

HISTORY AND USES.

The subject of this paper is one which the author begs leave to present, thinking that it may be profitably considered. His own interest was awakened in nickel some years ago when making an inspection of an important group of nickel mines, and the works connected with them, in Germany, but the superior attractions of gold and silver mining have prevented him till now from reviving it. The discovery that nickel was a new *element*, was made by Cronstadt in 1754, and he named it after the mineral kupfer-nickel, in which it was discovered by him, but it was reserved to Bergman in 1779 to show that nickel was really a new *metal*. Kupfer-nickel was described by Hierne in 1694, and its name indicates the low value set upon such ore by the German miners in those days. Kupfer-nickel in fact might be freely translated into English as "Old Nick's copper," the term nickel being probably derived from the Low German "nikker," which stands for the devil or hang-man.

Deceived by the copper colour of the mineral, the miners no doubt mistook it for copper ore,

and probably gave it the name to warn future generations against what they, not unnaturally, regarded as a fiendish imposition on them; the miners, however, would no doubt tell you that it was due to the metallurgist's command of bad language, as they discovered that when cobalt ores became over-roasted in the manufacture of smalt the nickel they contained followed the former metal, and combining with the silica, spoilt the blue colour of the glass the makers wanted to produce. To quote a most instructive paper on nickel, read before the Colorado Scientific Society, December 4, 1893, by W. T. Austin, one may say that "Nickel has not received from scientific men the attention to which it is entitled, and the subtle influences exerted on the physical properties of its alloys by the admixture of exceedingly small quantities of other elements, have mystified the practical man (so-called by courtesy) and kept him in the background. For more than a century nickel puzzled and perplexed all who had anything to do with it, and its history is a long story of contradictory statements and mistakes." It seems to me it is a capital metallurgical illustration of the proverb, "Give a dog a bad name." But granted so, a bad dog may sometimes be broken in, and become of service to its owners.

The literature dealing with the subject is exceedingly scanty, on the one hand because the properties of the metal have been insufficiently studied by those who would naturally be expected to investigate them from an economic point of view, and, on the other, because the interests of pure scientists in this field has for some reason lain dormant. Another cause is the secrecy maintained for so long a time by those manufacturing nickel products with regard to their processes and methods. This policy, which, it is to be presumed, has generally for its object the idea of deterring competitors from entering a special field, is surely a short-sighted one, as it may well be doubted whether manufacturers are ever benefited in such cases by jealously excluding the scientific discussion of their methods of treatment; experience in the rapid development of the iron and steel trades, in one instance, at any rate, going to prove the benefit of adopting an opposite policy.

Nickel has certainly maintained a high price in the past, but at the cost of an exceedingly limited consumption of the metal, and the original discoveries of ore in Scandinavia, Germany, and the United States, furnished the trade for

many years. It was only with the increased demand for the metal, induced by its more extended applications, that prospectors began to busy themselves and look around for larger supplies of ore, and the result has been the discovery of most important new fields, like those of New Caledonia and Sudbury in Canada.

Austin traces four marked stages of development in the modern history of nickel.

1st. The century or more when the presence of some unusual metallic combination was recognised to exist in certain minerals, during which time the metal was introduced into the arts as an alloy known as "white copper," consisting chiefly of copper and nickel with a small proportion of zinc, closely resembling silver, tough, easily worked, and not tarnishable when exposed to gases containing sulphuretted hydrogen.

2nd. The period which commenced with the manufacture of German silver on a large scale at Berlin (about the year 1824), when nickel obtained a recognised position, Brandes having shown, the year previous, the exact composition of the new alloy.

Up to 1838, nickel was wholly derived from its arsenide ores, and it was not till then, when Berzelius is thought to have discovered nickel in the Klefva cres (Sweden), that Aschen made his first smelting experiments upon the nickeliferous pyrrhotites and pyrites of that country. The metallurgical losses were at first heavy, but between 1849 and 1851 Berdberg laid down certain principles, which have held good in nickel-metallurgy up to the present time.

3rd. The period which dates about this time (1850, when Switzerland adopted nickel for subsidiary coins) marks another era in the history of the metal. In 1888, it was first successfully alloyed with steel on a scale of commercial importance, and this has given nickel a fourth periodic impulse, which has only just practically commenced, and promises to far exceed all the preceding ones in its results. The world's production of metallic nickel has increased within the past 10 years from 1,000 tons per annum to over 5,000 tons, whilst previous to 1876 not more than 600 tons were produced in any one year. As far as our knowledge at present extends, the principal value of nickel seems to lie in the properties of its alloys. For example—

(1.) German silver is of such general utility that articles made of it are everywhere to be found in household use.

(2.) Alloys of nickel and copper have largely supplanted the smaller silver coinage of several European countries and America.

(3.) A small per-centage of nickel, incorporated into steel, has provided the engineer with a structural material, superior, for many purposes, to the best carbon-steel made.

(4.) Pure nickel, in the metallic form, is used for plating other metals; and though its cost is at present too high to admit of wide use, it is employed for making numerous small articles.

To give one instance only. A short time back the interest aroused in me by nickel, combined with the conviction that silver, under existing international currency conditions, at even 29½ an ounce, was an extravagant luxury, induced me to extend the application of nickel, by having a cap of it set on the handle of my old, but valued umbrella.

Austin predicts that nickel will be put into the form of ferro-nickel, suitable for making commercial steel, at no distant time, in not more than three operations, without innumerable bye-products being left over to work afterwards. At present, the simplest and most direct method of treatment includes at least seven distinct stages—roasting, matting, Bessemerising—after which it has to be "topped and bottomed," refined, reduced to oxide, and finally incorporated, not to mention all the side operations of working up the bye-products. It is a subject indeed to which English metallurgists might, in all probability, profitably turn special thought.

Before the Christian era, nickel was employed for coinage purposes by the Bactrian king Euthydemus, 235 years B.C., and analysis of these coins shows that they were evidently intended to contain 22 to 23 per cent. of nickel to 77 or 78 per cent. of copper, closely approximating curiously enough the proportion of 25 to 75 per cent., which experience has taught us is the most desirable admixture of these metals for use in coinage. It is remarkable that Euthydemus hit upon this particular ratio of copper to nickel, and the fact that analysis shows no arsenic, debars rich arsenical ores from being a source from whence the nickel employed was derived, and points to the use of sulphides, as the silicates could scarcely have been treated at that time. If this be so it indicates considerable metallurgical skill on the part of the early smelters, and considering the nature of the metals employed, it is

hardly probable the alloy was a haphazard mixture.

Prof. Roberts-Austen mentions also that long before Europe awoke to the value of nickel, that enterprising person, "the Heathen Chinese," was making an alloy of nickel, and shipping it to Europe for a century or more, under the name of "Pack Fong*," or "white copper."

Just before the commencement of the second period, before alluded to, nickel appears to have been discovered in the United States, when, in 1818, Seth Hunt opened up the cobalt mines near Chatham, Connecticut, and shipped some of the ore to England, where it was reported upon and stated to contain nickel. These mines, in 1854, were said by Whitney to be the principal sources of American nickel, but from the fact that they were repeatedly taken up and abandoned, they no doubt proved commercially unremunerative.

The principal deposit of nickel opened up to date in the United States, the celebrated Gap Mine, appears to have been discovered somewhat later, viz., in 1718, and was being worked for copper in 1744. It was not, however, till 1852, when the property came under new management, having proved unsuccessful as a copper "proposition," that investigations began to be made as to the nature of the yellow sulphide ore, looked upon as worthless mundic by the former owners, and thrown by them over the dump. The first tests were not conclusive, but, in 1853, Dr. Genth, of Philadelphia, pronounced it to be millerite. During the third period in the history of the metal, in 1862, Joseph Wharton acquired the Gap property, and put it into operation as a nickel producer, in May, 1863, starting a refinery at Camden.

At the Centennial Exposition in Philadelphia, in 1876, Wharton made an exhibit of nickel products, such as had not been seen elsewhere up to that date; and in 1878 he showed articles made of pure nickel, both forged and cast, which were so remarkable that they excited at first considerable incredulity.

In 1804, Richter had succeeded in producing malleable nickel, but subsequent investigations met with very variable results, through neglect in recognising the important part played by small quantities of impurities alloyed with the metal. A new future for nickel as a metal,

apart from its alloys, dawned when, in 1879, Fleitmann found that by the introduction of small amounts of magnesium just before pouring, the quality of the nickel was improved; Garnier subsequently accomplishing the same end, by the use of phosphor-nickel. This third period is likewise marked by the important event of the discovery, in 1876, of immense quantities of hydrated silicates of nickel and magnesium (garnierite) in New Caledonia, which placed an exceedingly valuable material at the disposal of manufacturers, opening up the possibility of producing a purer nickel from ores free from the usually accompanying deleterious substances, reducing the price of the metal, and extending its uses. Nickel ores had been discovered in the island some years previously, but it was not until 1876 that they began to influence the market. These new ores contained the nickel in the form of protoxide, free from cobalt, copper, sulphur, and arsenic, and, consequently, required an entirely different system of treatment from that by which the sulphide and sulpho-arsenide ores had been handled.

Some years previous to the appearance of the New Caledonia silicates at the metallurgical works of Europe, somewhat similar ores had been worked at Ickatarinenburg, in Russia, others were known to exist in Spain, and since then further deposits have been found in Oregon and North Carolina.

In 1876, the production of the Scandinavian mines reached its maximum height, the yield of Norway being 360 metric tons of metal, and that of Sweden considerably less than 100 tons. Since that date the production of this district has very considerably declined.

Nickel silicates were discovered in Douglas county, Oregon, in 1881, and have lately been exploited by an Anglo-American company, whilst in 1884 deposits of nickel ores were proved to exist in Churchill county, Nevada.

The Pacific Coast mines are said to be the most promising deposits at present known to exist within the boundaries of the United States, but distance from market, and the discovery of nickel in Canada, have militated against their development.

In 1856, Mr. Alex. Marray pointed out the occurrence of a dingy green magnetic "trap" at a point 10 miles south-west of what is known as Sudbury in Canada, and this rock, upon analysis, showed small quantities of nickel and copper.

The first discoveries of any commercial importance were not made until the building

* According to an analysis of a specimen in Dr. Percy's collection at South Kensington composed as follows:—Copper, 4.4 per cent.; zinc, 25.4 per cent.; nickel, 31.6 per cent.; iron, 2.67 per cent.

of the Canadian Pacific Railway in 1883, and early in 1884, when a cutting on the line pierced a small hill about $3\frac{1}{2}$ miles south-west of Sudbury, exposing the deposit since known as the Murray Mine.

In the spring of 1886, the Canadian Copper Company was formed to operate the Copper Cliff (Stobie and Evans' mines), but it was not till 1888 that the company erected their first furnace. Shortly afterwards a number of companies entered the field, amongst others Vivian and Co., of Swansea. These Canadian mines, which are in the districts of Algoma and Nipissing, in the province of Ontario, have of late years attracted world-wide attention, first, on account of their apparently inexhaustible character; lately, because of the new applications of nickel in the manufacture of nickel-steel. One is apt to overlook nickel in its mineralised forms, and the Sudbury ore bodies were originally opened as copper mines.

The unusual properties displayed by meteoric iron, in regard to its extraordinary toughness, and in some instances its non-corrodability, coupled with the fact that it is invariably associated with nickel and other elements, has of late years drawn attention to the influence which nickel exerts when alloyed. Faraday, Berthier, Longmaid, Liebig, Fairbairn, and Boussingault Künzel, and even Ledebur, all investigated the subject, but all efforts to manufacture a valuable alloy of iron and nickel were in vain, until a few years ago, when the fourth era of nickel commenced; the trouble was that the immense influence of minute quantities of other accompanying metals and metalloids, was unsuspected. Probably, the first appearance of nickel-iron alloys in the United States was when Philip Thurber, of Detroit, exhibited some products of the iron furnace at Marquette, Michigan, at the New York Exposition in 1853. This iron was made from a nickeliferous limonite, and possessed some remarkable qualities, but it was not till 1888, after experiments had been made by Marbeau in France, with crucible nickel-steel alloys, that James Riley took the subject up, and began experimenting in Scotland with similar manufactures, produced in the open hearth, and convinced himself and the metallurgical profession of the genuineness of the claims advanced for this new material. The results are given fully in a paper read by him at the Glasgow meeting of the Iron and Steel Institute, May, 1889.

Notable among these, was an alloy containing 4·7 per cent. nickel, which showed an

elastic limit of 28 tons per square inch and a breaking strain of 40 tons, whereas similar steel without nickel, showed only 16 tons and 30 tons respectively. The elongation and contraction of area of this steel, were not more-over materially impaired. In a series of competitive armour trials, made at Annapolis Maryland, in September, 1890, the palm was awarded to a French nickel-steel plate, and Mr. Tracey, at that time Secretary of the U.S. Navy, gave orders to have further trials of similar material made, which had been manufactured of American material by American mills, with a view to decide the best material for protective armour, for the new men-of-war being built. These tests as reported by Mr. W. S. Abbott, of Carnegie, Phipps & Co., gave an ultimate tensile strength of 100,000 to 102,000 lbs. per square inch with an elastic limit of 59,000 to 60,000 lbs. The elongation was $15\frac{1}{2}$ per cent., with a reduction of area of $29\frac{1}{2}$ and $26\frac{1}{2}$ per cent. respectively at fracture.

The toughness of nickel steel is shown by the fact that blocks cut from the armour plates at Bethlehem, many of them weighing several tons, cannot, by any method yet devised, be profitably broken up into sizes suitable for returning them to the furnaces. It is stated also that experiments lately made by the German Government, show that shells exploded in ordinance made of ordinary steel, badly injured it; whilst with nickel-steel, it was only enlarged. *New York Engineering and Mining Journal*, March 11, 1893, "Ordinary gun steel contains 0·3 to 0·5 of carbon, and may contain 0·8 of maganese."

One by one the objections raised against nickel-steel have been removed, the effect of cold weather on the plates for instance having been experimentally demonstrated to be of no consequence, if one may judge from a series of experiments carried out at the United States Navy yards since 1891.

The tough tenacious material flows under the impact of the shot, and in the case of "Harveyized," i.e., surface hardened plates, the extreme hardness of the exterior, reinforced by the tough untreated steel behind, shatters the forged steel Holzer projectiles, which have hitherto proved irresistible.

These shells are made, I believe, of highly-carbonised steel, containing 0·8 to 0·94 of carbon, and, in addition, 0·94 to 2 per cent. chromium. Nickel steel is practically incorrodible, and can be advantageously made on the basic, open-hearth furnace. Professor Roberts-Austen, p. 48 of his valuable "Intro-

ductions to the Study of Metallurgy," states that nickel has an atomic weight of 58·60, atomic volume of 6·7, specific gravity of 8·80, specific heat 0·110, melting point 1,600, coefficient of linear expansion, 0·0000727; electric conductivity, 7·374. Quoting the investigations of Riley, he gives a diagram, which shows that nickel up to 7 per cent. materially increases the tensile strength of steel and its elastic limit, whilst its extensibility is as rapidly diminished.

Though there has been no material increase in the established channels of consumption, except it be for plating, whilst 1,000 tons of nickel flooded the market in the early years of the century, 10,307,275 lbs. or, roughly, five times as much, was produced in 1891, consequently the large excess of metal produced must have gone into nickel-steel, yet this alloy has scarcely begun to be used in the arts of peace. As its price tends steadily downward, we may confidently expect that it will eventually enter into competition with other materials for other purposes than armour-plates and guns. Though there is always naturally some hesitation in adopting a comparatively untried material, where it is subjected to extremes of temperature, such as for boiler-plates, bridge-building, and marine engineering, experiments are going on all around us, and last year it was decided to place sections of nickel-steel propellor-shafting in the U.S. protected cruiser *Brooklyn** and the battleship *Iowa*. The ordinary carbon-steel used for such purposes has a tensile strength varying from 60,000 to 65,000 lbs. per square inch, whereas the nickel-steel will show a tensile strength of 90,000 lbs. per square inch, the elongation in both cases being about the same, 20 per cent.

Using this stronger steel will warrant boring out the shaft, materially lessening the weight whilst preserving its efficiency, and such cored-shafting can be hollow-forged when the hole is large enough to admit a mandril.

If it is found possible to apply it to the construction of boilers, the tensile strength of nickel steel being $1\frac{1}{2}$ times that of ordinary steel, it will enable their thickness to be reduced one-third, effecting a saving in weight, which is often a great consideration. Jules Garnier gives in "Le Genie Civil" the results of a series of tests made in 1892, at the Cleveland Rolling-mill Company's works, on nickel steel. The nickel was produced at the Brook-

lyn Nickel Works, from Sudbury ore, by the Canadian Company. The comparative results of these trials, by the side of others on ordinary steel made and tested under identical conditions, are given in the *New York Mining Journal* of February 25th, 1893, and the deductions drawn from them were—

(1) Nickel steel has a higher elastic limit of some 11,400 lbs. per square inch, or nearly 31 per cent. more than ordinary steel.

(2) The tensile strength of nickel steel is greater by some 10,400 lbs. per square inch, or an increase of about 20 per cent.

(3) The ductility of steel is not reduced by the presence of nickel.

During last summer the Bethlehem iron-works completed a spare shank-shaft for the American liner *Paris*, using nickel-steel of about 90,000 lbs. T.S., which is said to be 25,000 lbs. in excess of any German or English manufactured steel, with the exception of the material turned out by one firm in this country, which has adopted steel of a similar character. Another important channel of consumption is the manufacture of a nickel-copper alloy (Ni 20 per cent., Cu 80 per cent.), for casing bullets to be used with small bore rifles now adopted by all the armies of Europe. This alloy has a higher degree of tenacity than the best brass, combined with a higher coefficient of elongation. The possibilities opened up by the uses to which nickel alloys may be applied by engineers in different branches of business may well attract the attention of miners and capitalists to deposits from which supplies of the metal can be got. The ores of nickel include the following minerals:—

Sulphides.

	Nickel. per cent.
Millerite, NiS	64·6
Polydymite, Ni ₄ S ₅	59·4
Beyrichite, Ni ₃ S ₄	54·2
Pentlandite, (FeNi)S	34·0

Arsenides and Sulpho-arsenides.

Niccolite, NiAs.	43·9
Rammelsbergite and Cloanthite, NiAs ₂ ..	28·1
Gersdorffite, NiAsS	35·4

Sulpho-antimonides.

Breithauptite, NiSb.	32·8
Ullmanite, NiSbS	27·8
Wolfachite, Ni(AsSb)S	29·8
Coryite, Ni(AsSb)S	28·8

Silicates.

Genthite, 2NiO·2MgO·3SiO ₂ ·6H ₂ O	22·6
Garnierite, H ₂ (NiMg)SiO ₄ + Ag	25·0

* *New York Engineering and Mining Journal*, November 26th, 1892.

Connarite, $\text{H}_4\text{Ni}_2\text{Si}_3\text{O}_{10}$	31.4
Rewdanskite $(\text{NiFeMg})_3\text{Si}_2\text{O}_7 + 2\text{H}_2\text{O}$..	28.1

Sulpho-bismuthide.

Kallilit, NiBiS	19.0
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Telluride.

Melonite, NiFe_3	23.8
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Oxides and Salts.

Bunsenite, NiO	78.5
Nickel oxide, Ni_3O_4	73.1
Morenosite, $\text{NiSO}_4 + 7\text{H}_2\text{O}$	20.9
Annabergite, $\text{Ni}_3\text{As}_2\text{O}_8 + 8\text{H}_2\text{O}$	29.4
Cabrerite $(\text{NiMg})_3\text{As}_2\text{O}_8 + 8\text{H}_2\text{O}$	25.1
Forbesite, $\text{H}_2(\text{NiCo})_2\text{As}_2\text{O}_8 + 8\text{H}_2\text{O}$	14.4
Lindackerite, $3\text{NiO} \cdot 6\text{CuO} \cdot \text{So}_3 \cdot 2\text{As}_2\text{O}_5$.	
$7\text{H}_2\text{O}$	12.9

Carbonate.

Zaratite, $\text{NiCO}_3 \cdot 2\text{Ni}(\text{OH})_2 + 4\text{H}_2\text{O}$	46.8
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It may be mentioned that millerite has been found in Iowa, forming tufts of beautifully arranged needles, in large, perfectly transparent crystals of calcite, in the compact lower carboniferous limestone of the Keokuk quarries, some 20 feet below the "geode-bed;" in cavities running up to 20 inches in length, thickly set with rhombohedrons of this peculiar character.

THE DISTRIBUTION OF NICKEL.

Geologically, nickel ores are usually divided into three main groups, which broadly correspond with the following classification.

Vogt has employed this subdivision as a foundation for a genetic classification. His groups are:—

(1.) Arsenides, which include sulpho-arsenides and sulpho-antimonides, as well as combinations of the metal, with sulphur and bismuth.

(2.) Sulphides, such as nickeliferous-pyrrhotite and pyrites, millerite, &c.

(3.) Silicates, garnierite, genthite, &c.

A brief description of a few typical examples of each group is interesting, as throwing light on the general occurrence of the ores of this metal.

The first of these groups is found in veins in Hungary, of the Dobschau type, and in the so-called Kopaltrücken, typified by the Richelsdorf Bieber veins. They occur also (as subordinate minerals) in the silver bismuth cobalt veins of Schneeberg, in the ordinary silver-lead veins of Freiberg, and in the Gem mine of Fremont, Co. Colorado.

In addition to nickel cobalt ores of various kinds, Von Groddeck shows that the typical Dobschau veins carry copper, and all these

three metals are found in the serpentines and older eruptive lime-olivine rocks, which form "the country" of the veins, and appear to have been produced from the decomposition of the adjacent rock masses, composed of olivine and gabbro. A vein of this class is found at Dillenbergl in Nassau, in pickrite, altered to serpentine, and contains millerite, bismuth-glance, pyrite, and other sulphide minerals. This vein was only productive in the serpentine, becoming barren when it passed into the adjoining schaalstein country.

The gabbro in the neighbourhood of Dobschau, which has been partly altered, as before mentioned, to serpentine, is fringed by a peculiar green silicious schist, resting on gneiss and granite. The veins occur between the gabbro and the schist, do not possess well-defined walls, and often reach a width of 25 feet.

The Schneeberg deposits, which likewise belong to this group, have a special interest for me, as I visited the district in 1880, and had an opportunity of examining its geological features, although my attention was more particularly directed to a study of the methods of dressing these ores, which present particular features of interest in their details.

The veins chiefly occur in mica-schist, which passes into clay-slate, more rarely entering the deep seated underlying granite, which, along with basalt, is found in intrusive masses, penetrating the overlying formation in the neighbourhood of Schneeberg.

The chief group of nickel cobalt veins lies round Neustädte, and, in general, strikes from N.W. to S.E., the dip being in some cases N.E., in others S.W., but in all cases highly inclined. The gangue is called, by Von Cotta, hornstone, and they carry, in addition to nickel and cobalt, bismuth, copper pyrites, and silver. He considers them to be veins of infiltration, formed by percolating mineral waters.

Closely connected with this system of veins is an independent group of copper lodes, which strike N.E. and S.W., with an almost vertical dip to the N.W. These show a great variety of copper and other minerals, amongst which may be named copper pyrites, bornite, copper-glance, tetrahedrite, cuprite, tenorite, chrysocolla, malachite, azurite, galena, cupreous sulphur of lead, cerusite, pyromorphite, iron and arsenical pyrites, blende, native silver, jasper alophane, diopside, barytes, and brown-spar, a veritable mineralogical museum. The nickel-cobalt ores as they are delivered to the dressing works average, I was told, 4 to 6

per cent. of cobalt, 3 per cent. of nickel, and 8 to 10 per cent. of bismuth.

The second or sulphide group of nickel deposits embraces those of Sudbury, Ertali, Piedmont, Varallo, and other places, and possesses very wide distribution, and marked geological characteristics. Vogt assumes this class of deposits is usually formed by a process of differentiation, or segregation from a basic eruptive rock-magma, and they are distinguished by the peculiarity that the ore chiefly consists of pyrrhotite, which carries, disseminated through its substance, various nickeliferous sulphide minerals, such as millerite, polydymite, and pentlandite, whilst chalcopyrite and titaniferous iron usually accompany the iron-pyrites, as accessory minerals. The largest and best known deposits of this class are at Sudbury, in Canada, where the ore is found in irregular, lenticular masses in the Huronian rocks, apparently conformable to the planes of bedding, and invariably in proximity to dykes or uptilted sheets of greenstones (diorite) and diabase. From the fact that the greenstones themselves are found at times with ore disseminated through them, Merritt thinks the nickel has been brought to the surface by the agency of these dykes. The region has been much faulted, and in places the pyrrhotite and chalcopyrite form a breccia, in a dark, dioritic matrix. The main range is about 50 miles long, and one to four miles wide, running N.E. and S.W. from Lake Wahnapiac to the Spanish river. The nickel-deposit outcrops are described as forming hills or ridges.

According to Mr. D. W. Browne, the ore frequently loses the character of a copper ore, which it possesses at surface, becoming more and more nickeliferous, and less cupriferous in depth. To illustrate this, he cites (*New York Engineering and Mining Journal*, September 16th, 1893) the Copper Cliff Mine, stating that on the 4th and 5th levels the ore carries 4 per cent. of copper, and 4.5 per cent. nickel, whilst on the 7th level many "stopes" show an average of 0.5 per cent. Cu., and 8 to 10 per cent. Ni.; the evidence, however, so far, would hardly appear to be sufficiently extended to warrant founding any general conclusions of similar enrichment, in other cases, taking place, founded upon what may turn out to be an exceptional occurrence.

As far as the Sudbury deposits have been exploited, down to a depth of 600 feet, there is no sign of falling off in the grade or quality of the ore. It contains in bulk 1 per cent. to

about 5 per cent. Ni, and 1 per cent. to 4 per cent. Cu, and cobalt; traces of gold and silver; and platinum, in the rare form of sperrylite (arsenide of platinum), is found in it. Ph. Argall, of Denver, in a most interesting paper read before the Colorado Scientific Society, December 4, 1893, gives the following analyses of an average month's output of the Copper Cliff, Evans, and Stobie mines, to illustrate the ratios between the nickel and copper contents of the ore:—

	Copper Cliff. Evans. Stobie.		
Cu	4.31	1.43	1.92
Ni	5.57	3.74	2.36

A division of value is effected in the ore simply by screening. Thus at the Evans Mine it is found—

	Per cent. Cu.	Per cent. Ni.
The coarse ore carries..	1.62	3.45
The raggings	2.99	3.90
The fines	3.78	5.04

The ore is sorted by hand into four grades—1st, the average mixed ore (nickel-copper); 2nd, copper pyrites; 3rd, pyrrhotite or nickel ore; and 4th, gangue. The closeness with which this separation can be made is shown by the following results:—

	Cu. per cent.	Ni. per cent.
<i>Mixed Ore:—</i>		
Copper Cliff	5.67	4.75
Stobie	2.21	2.28
Evans	2.60	4.00

Picked Copper Ore:—

Copper Cliff	14.13	2.74
Stobie	15.71	1.23
Evans	13.86	1.34

Picked Nickel Ore:—

Evans	0.80	8.12
Copper Cliff	0.49	5.36
Average diorite rock.....	0.80	0.70

This Table shows that the pyrrhotite carries the principal nickel value, in comparison with which the chalcopyrite is quite lean, and that these ores are not intimately admixed.

The Report of the Ontario Bureau of Mines shows that 8 mines operated by four companies produced 85,790 tons of ore, which probably cost about \$5.00 a ton to produce in 1891. The whole lot averaged 2.62 per cent. nickel, therefore the nickel in the state of ore cost about 10 cents. per lb.

The cost of succeeding operations to produce one ton of nickel oxide, containing 76 per cent. of metallic nickel, may be estimated to be \$140.74 dealing with these pyrrhotite ores. Its mining and transport can be reckoned at 10 cents. per lb.; conversion into

oxide, 9 cents.; reduction into metal, 8 cents.; and allowance for loss in working, 4 cents.; total, 31 cents per lb.

Vogt endeavours to trace a constant ratio between nickel, pyrrhotite and chalcopyrite occurring in ore deposits in certain rocks, stating that while in each mine the ratio may vary from day to day, that the ore ratio over a long period will give constant results. He gives a Table showing the ratio for eight of the principal mines in Norway and Sweden. In them the copper contents corresponding to 100 parts of nickel, vary from 20 to 80 and average 43; whilst the nickel and cobalt contents in 100 parts pure pyrrhotite, vary from 2.5 to 7.5, and average 3.8. Thus he claims for ores produced by a segregative process, from one and the same eruptive, such as norite, there is a ratio between the proportion of nickel to copper on one side, and the absolute nickel contents of the pure pyrrhotite on the other. The higher the nickel contents of the pyrrhotite, just so much lower is the ratio of copper to nickel. This phenomenon cannot have occurred by chance, but results probably from the relation existing between the small contents of Cu and Fe, held in the silicates of the original eruptive magma.

Mr. Browne has determined that the nickel exists, in the pyrrhotite of the Copper Cliff and Evans ore, chiefly as pentlandite (Ni Fe)S, two-thirds of it being in this mineral-form, and he ascribes the enrichment of the ore in depth to the increased amount of pentlandite found in the pyrrhotite of the deeper levels. He claims that the finer grained the ore is the more the nickel exists as an element, replacing the iron in the pyrrhotite, whilst experience has shown that the coarser grained the ore, and the deeper it lies below the surface, the more it occurs as pentlandite with the pyrrhotite.

S. H. Emmons (New York *Mining Journal*, December 24, 1892) describes three new nickel minerals, which he discovered in the Sudbury ore, viz., *folgarite*, found at the Worthington mine, having a composition represented by the formula NiS FeS ; *blueite*, discovered in the workings of the Emmons Company's mines, composition $\text{NiS}_2 \cdot 12 \text{FeS}_2$; and *whartonite*, found at a mine 7 miles south-west of Sudbury, supposed to have the composition $\text{NiS}_2 \cdot 7 \text{FeS}_2$.

In the Gap Mine of Lancaster, Co. Pennsylvania, we have another example of a nickel-sulphide ore, consisting of millerite associated with pyrrhotite, impregnating a lenticular mass

of hornblende rock, embedded in mica-schist at or near their planes of contact. It has been suggested that this hornblende mass may prove to be an altered eruptive, whilst it is not unlikely that an adjoining trap-dyke had some influence in the formation of the ore body.

According to Blake, the ore runs 1.5 to 2 per cent. Ni, whilst Whorton averages it from a series of his analyses, at 3.6 per cent. Ni and Co., and 0.75 per cent. Cu.

For a third example, we may turn to the Norwegian pyrrhotite deposits, in which the ore occurs chiefly at the contact of the eruptive norites (massive hypersthene gabbros), with the archæan country schists.

It has been pointed out by Stephen Emmons and others that the plane of contact between eruptive and sedimentary or metamorphic rocks offers a favourable passage for the circulation of mineral solutions.

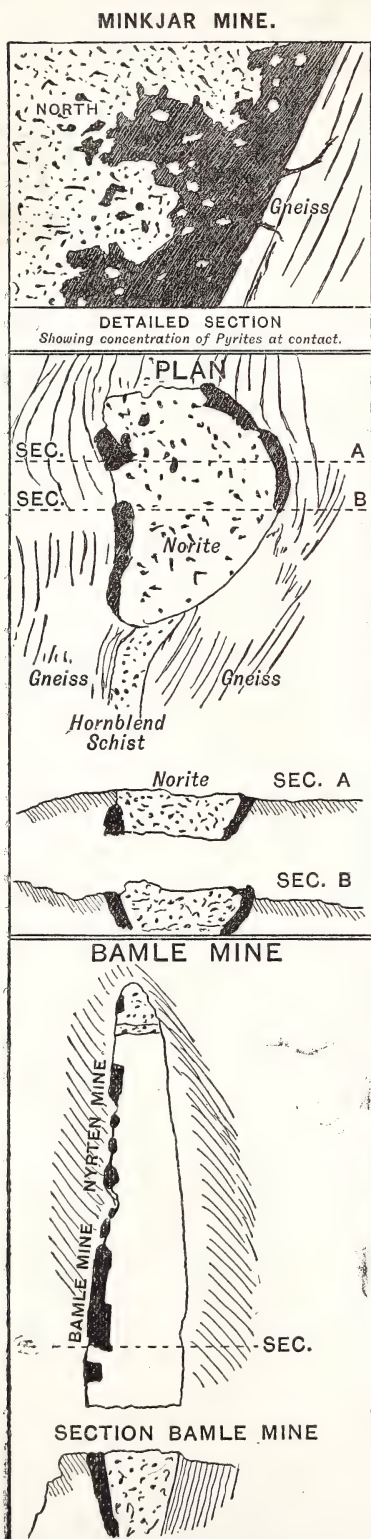
A section of the Minkjar Mine (Fig. 1, p. 504) represents a familiar ore deposit of this type, such as is usually assumed to have been so deposited. The norite body shown in the general plan is 243 feet long by 135 feet wide, and is almost entirely surrounded by an irregular deposit of pyrrhotite, from 3 to 6 feet thick. The detailed section illustrates the transition from a normal norite, first into pyrrhotiferous norite, and afterwards into almost pure pyrrhotine, concentrated on the immediate contact of the gneiss, into which small veinlets occasionally branch off. Ore bodies are also found in the norite, along the contact of included masses of schist.

The third or silicate group of nickel deposits are best represented by those of New Caledonia, which have been described recently in a paper read by Mr. J. Garland, before the Institute of Mining and Metallurgy, and by other writers.

Mons. Heurteau, I believe, made a detailed geological survey of the island in 1873, which led to mining operations being commenced.

The base of New Caledonia seems to consist of a light-coloured non-fossiliferous schistose-rock, on which secondary and tertiary rocks rest, and about one-third of its area appears to be covered by massive serpentines, which are most prominent in the east and south-east parts of the island.

According to Mons. David Levat (study of the deposits of Ni, Co, and Cu in New Caledonia, *Association Française pour l'avancement des Sciences, Paris*, 1887), the nickel occurs solely in the form of magnesian hydrated silicates of a beautiful apple green colour when pure, as coatings or concretions, in the fissures of the



After Vogt.

FIG. 1.

serpentine; and he concludes, from the absence of arsenides or sulphides of nickel, that their mode of occurrence points to the deposition of the ore from solution, in the state in which it is now found. The pure mineral, he reckons, often averages 26 per cent. Ni, but the average ore, after sorting, does not carry over 10 per cent. mixed with some serpentine gangue. Garland puts the average quality of the ore shipped to Europe at only 7 to 8 per cent. of metallic nickel, stating that ore of less than 6 per cent. is considered unmarketable, and cannot be sold. The darker green the colour of the silicates, the richer the ore seems to be, some specimens appearing to shade off into almost pure silicate of magnesia, which are almost white, containing only traces of nickel. Mons. Peletan has found cleopters enclosed in crystals of the green silicate.

This green silicate is not, however, the only form in which nickel ore occurs in the district, as most valuable deposits are found of a brown mineral, of nearly the same composition, which Mr. Garland states is generally the richer of the two. It seems to consist of green silicate, in which part of the magnesia is replaced by hydrated oxide of iron (limonite) which gives it this brown colour. Treated with dilute hydrochloric acid, the iron is dissolved out, leaving the green mineral garnetite, which shows that the iron is not chemically combined, but merely mechanically associated with it. The deeper brown it is, the richer the ore is reported to be. This is remarkable, and points again to the fact before remarked, that association with iron appears to affect the nickel contents of the ore in a favourable way. This brown ore has a very light specific gravity, only 3.00, and Claudet gives an analysis of it as follows:—

Oxide of nickel	12.25	per cent.
(= nickel 9.64 per cent.)		
Oxide of iron	32.20	„
Magnesia	3.07	„
Alumina	3.62	„
Silica	34.80	„
Water at 212° Fahr.	6.43	
Water above 212° Fahr.	7.07	
	99.44	

The per-centage composition of both the green and brown minerals varies greatly, and the above analysis may be presumed to be below the average, as Garland states that omitting minor constituents, the average of 12 analyses of the green garnetite made by Prof. Liversidge, show SiO_2 44.75, NiO 19.73,

MgO 15.25, and the Government year book for 1891 states that the richer mineral has sometimes the following composition :—Silica 45, nickel 26, magnesium 13, iron 3, water 13. I am also informed by Mr. Gregory that he found millerite in a sample of the ore from New Caledonia.

According to Levat the massive serpentine itself contains nickel in proportions varying from 1 to 3 per cent., and in some cases even 5 per cent. He further inclined to the belief that the protoxide of iron of the serpentines diminish as soon as the nickel appears in them, and the total of the two metals remains constant, but when his paper was written he had not had the benefit of a microscopical examination to determine this. He lays great stress on the fact that the nickel ores, though found exclusively within the serpentine area, are not distributed there in an arbitrary manner, but always occur at, or in the neighbourhood of certain beds of red clay (vasques), which Mr. Garland describes as looking in the distance like huge scars on the face of the hills. Levat says they appear black in the centre and red at the edge, when seen in the distance from the sea, and they are often ranged one above another like stairs on the flank of the hills giving a most characteristic profile. The former observer, however, denies their argillaceous character, stating that they contain practically no alumina, but consist almost entirely of iron and silica, with 1 to 3 per cent. of nickel, and he gives two analyses in proof of this contention.

The existence of these basins of red clay, or earth, as they might perhaps (from what has been said) be more properly called, is certainly a most curious feature in the geology of New Caledonia, scarcely less extraordinary than that of the red pigs, for which the island is said to be famed, and possibly the colour of the latter may have some connection with the presence of these red deposits on the island. So much of the island appears to be coloured red by nature that it seems quite a pity in fact it is not red on the map.

The clays or earths are believed by Levat to be the products of the hydrothermal decomposition of the serpentines, as they contain all the elements of these rocks, in addition to iron, manganese, chromium, and cobalt. He supposes that numerous iron and manganiferous springs found vent through fissures in the serpentine and have eaten it away, leaving half dissolved masses of so called sugar-rock in the clay that fills the basins, which

in many places are capped by a deposit of oolitic iron ore, the product of the overflow of the ferruginous waters. Mr. Garland's observations that the ore is found in massive pieces in botryoidal, mammilated, and occasionally in stalactitic forms, and in brecciated masses, supports this view. It has been pointed out also as a remarkable fact that these deposits are mostly found at high altitudes (the mountains of the interior rising to a height of 5,576 feet, and averaging 1,640 feet), and in the lower lying serpentine areas they are non-existent, but I think it is capable of explanation, if we suppose that the serpentines are the altered products of volcanic action which overflowed in the interior of the island, as it is just there that the conditions would be found most favourable for the deposition of the minerals we have under review, under such circumstances. Veins of chrome iron ore also occur in the hard unaltered serpentines of New Caledonia,* whilst cobalt ore is likewise found in the red earths, the origin of which latter deposits are considered by Levat to be essentially hydrothermal. The chromium, on the contrary, he thinks, pre-existed in the serpentine, and was derived from it, whilst the nickel solutions only appeared after the deposition of the clay.

These solutions, circulating not only on the contact, but in the cracks and joints of the adjacent serpentine, would explain the deposition of the hydrated silicate of magnesium and nickel, in "Stockwerk form," which is the most usual mode of occurrence. The nickel ore is, however, also largely found, according to Levat, in a brecciated form on the roof or walls of the basins of red earth, being sometimes symmetrically deposited, when the axis of the basin is vertical (in which case the ore is of equal thickness on the walls); at other times the axis of the basin is inclined, and the serpentine which forms the roof is fissured, the cracks so found being often several metres wide, filled with rich ore, the nickeliferous solutions being unable to penetrate the clay finding a natural passage along the walls of the cavities. Where the circulating waters moved for a long time between the walls and the clay, fine striæ are found upon the latter (*Annales des Mines, 2nd livraison*). Levat further states, that the nickel deposits lie in a series of zones, running north-east and south-

* At the Gasconne Mine the serpentines are particularly rich in chromite, occurring in veins in the undecomposed rock, but breaking off suddenly at the contact of the serpentine and clay.

west, starting from the east coast, penetrating into the interior, and continuing, as Mr. Garland points out, to the west coast; outside of them there are only local encroachments, which lack uniformity.

Though in 1887, at the time Levat examined them, the deepest workings were only down 275 feet below the outcrop, he concluded that in depth they would lose their thickness, basing his opinion on the probability that the red earths with which they appear connected would not hold down to any great depth. Levat summarises the general characteristics as follows:—1st. The ore is essentially dependent on the serpentine of the east and south-east parts of the island. 2nd. Ores of cobalt, associated with manganese, are found in beds on the rim of the basins of the earth found traversing the serpentine in a number of places. These cobalt ores do not contain over two or three per cent. of Co., but they are very extensive, being mined simply by scraping up the material. 3rd. The deposits of chromium are of two kinds, either in veins in the serpentine or in stratified beds in the basins of earth. 4th. The nickel deposits are of later formation than either of the two preceding ones, and are situated exclusively at, or in the neighbourhood of the contact of these clays or earths with the serpentine, and never in the body of the former. They are united in a certain number of north-east and south-west lines, the width of which does not exceed, as before said, 600 metres.

The crystalline diallage, being less attacked than the other constituents of the serpentine by the mineral solutions which have eaten it away, forms a skeleton, which is sought for by the miners as an indication of ore.

True lodes appear to be absent, but some of the fissures filled with ore can be traced for considerable distances along their strike, possess regular walls and dip, have a width of 18 inches to 5 feet, and have been followed down, in one instance to a depth of 360 feet below the surface outcrop.

As the formation of the deposits in the basins of red earth is due, Levat thinks, to the shrinkage of those clays, their continuity in depth may probably depend, as he supposes, on the depth of the clays in the basins. It must not be supposed, however, that these deposits are likely to be speedily exhausted, as they have a very wide distribution indeed. They are mined in open quarries, in benches, when found as stock works; at other times, by tunnels and winzes. The work

is commenced by removing the red clay, which, if mixed with the ore, entails difficulties, as the grains of iron are with great difficulty separated by washing, and consequently appear in the matte produced. Moreover, the clay, being very aluminous (according to Levat) renders the siliceous ore still more refractory.

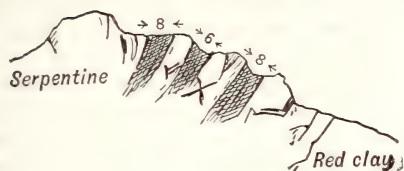
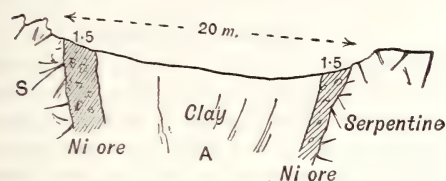
The gravity system of transport on a single rope at these mines is certainly extremely primitive, but is no doubt due to the necessity of frequently shifting the position of the terminals. It might, however, be improved upon by hauling up the empty bags and carriers on a carriage attached to the main cable by means of a small hoisting rope, operated by a windlass, instead of carrying them up, as is now done, on men's shoulders.

The principle of using gravity-inclines with double ropes has been satisfactorily employed underground at the Pierrefitte mines in the Pyrenees, in large open gunnices; the only instance I know of where such a system has been operated underground. It was introduced because the flatness of the lode would have involved shovelling, and it possesses obvious advantages over an inclined-plane, for a short temporary roadway in lofty workings.

According to Mr. Ph. Argall (quoting, I believe, from official sources), the output of nickel and cobalt ore from New Caledonia, in 1890, was 22,690 tons of (say) 10 per cent. nickel ore, and 2,200 tons of 3 to 5 per cent. cobalt ore, whilst, in 1891, the output of nickel ore had only reached 35,000 tons. Mr. Garland states, on the other hand, that these mines are now producing over 60,000 tons of nickel ore per annum; and to reconcile the two statements, I take it that he alludes to the crude ore. He puts the cost of mining at 6s. to 40s. per ton.

The first mechanical treatment of the ore consists of sorting and washing at the quarries, where a division is made into rich ore, carrying 8 per cent. and over of nickel, and poor ore under that amount. The ore is then carried to the plain below to be washed, so as to remove the red clay. The nickel has the same specific gravity as the serpentine, but less than the iron. The ore rejected at the quarry, although it contains 3 or 4 per cent. of nickel, is of no value. Garnier's first idea was to treat the ore in a blast-furnace, to obtain crude nickel and refine it; but this latter process presented such difficulties that it was abandoned. Fusion for matte was then tried, but was also given up, owing to the high price of fuel, and the inefficiency of the convict

labour. The cost of producing metallic nickel, dealing with such ores, appears to be—mining and transport, 10 cents; conversion into oxide, 3 cents reduction; into metal, 8 cents; allowance for loss of working, 1 cent; total, 22 cents.



- Oolitic iron ore
 Cobaltiferous manganese
 S. Serpentine decomposed at contact with clays.

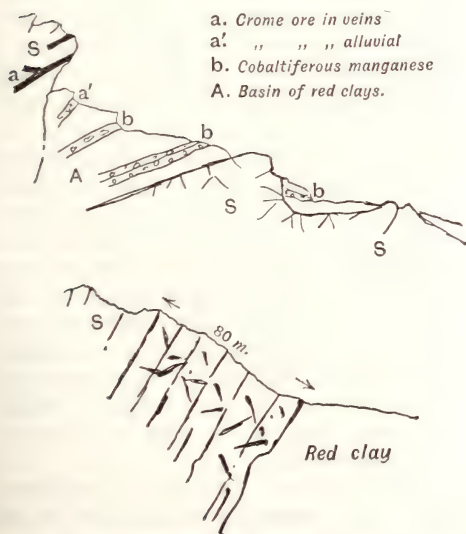
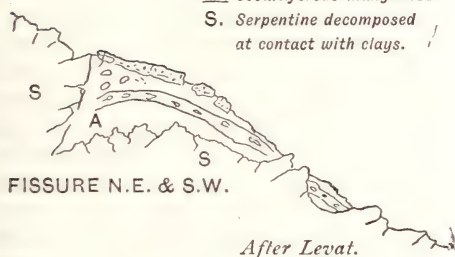


FIG. 2.—NEW CALEDONIA DEPOSITS.

I have here some interesting geological sections, copied after Levat, describing the features that have been mentioned. Deposits closely approaching in type those just described were

discovered in 1881, at Riddles, Douglas Co., Oregon, and others of a similar kind have been found at Webster, North Carolina. The Riddles deposits all lie at or near the surface, in beds 4 to 30 feet thick, occurring as a boulder formation, scattered through a ferruginous earth or in beds underlain by serpentine, and associated with chrome iron.

F. W. Clarke, *American Journal of Science*, vol. xxxv. p. 483, gives a typical series of analyses, which shows that the relative composition of silicate minerals obtained from New Caledonia, Oregon, and North Carolina agree very closely in composition and appearance. A fresh specimen of "country" was analysed from Oregon, and some olivine was found in it. The rock contained 0.10 per cent. NiO, the olivine 0.26 per cent. NiO.

This suggested to Clarke a probable source of derivation of the nickel in the altered beds of ore, and the microscopical investigations of Diller confirm his view. He considers the Riddles rock as belonging to the peridotites. It is a holocrystalline, granular rock, composed essentially of olivine, whilst one-third of the rock mass consists of enstatite, with a small per-centage of chromium and magnetite. Quartz is present from metasomatic change, and whenever genthite appears it is always associated with quartz or serpentine. The genthite occurs in the serpentine, directly connected with the grains of olivine, from which the serpentine has been derived, and Diller states there is every reason to think the genthite is primarily derived from the same source. Though the Webster rock (which is also a peridote, of the variety known as dunite) contains less enstatite, and the nickel silicates are not so closely intermixed with quartz, the relation of the genthite to the serpentine and olivine is the same as at Riddles. Of the New Caledonia genthite, Diller says, like that of Oregon, it is disposed in layers and cavities, thoroughly intermingled with quartz, and sections show the serpentine with traces of olivine and enstatite so disposed as clearly to indicate that the serpentine naumeite, and other secondary products, have resulted from the alteration of the peridote rock.

According to S. H. Emmons (*American Mining Journal*, April 30th 1892), the nickel deposits of North Carolina are found in veins of three distinct classes—1st, those occupying fissures, the strike of which is more or less normal to the planes of division, that give a bedded aspect to the chrysolite rock mass;

and, there are numerous caunter-veins, with a strike oblique to the first series; 3rd, there are bedded veins, located in planes of division. He is of opinion that the caunter and bedded veins will not be found very productive, and the first series will alone yield any considerable supply of ore.

A nickel iron josephinite has been lately discovered, in the form of pebbles and smooth boulders, in considerable abundance in the placer gravels of a stream in Josephine County, Oregon. They are supposed to have been derived from some dyke of ultra-basic rock.

Melville has described this alloy (*American Journal of Science*, vol. xliii. p. 509) which is highly magnetic. The pebbles are a greenish-black, with bright areas of a greyish metal. The greenish-black portion consists of silicates, some of which are indissoluble in HCl. Nickel is found in the Urals at Rewdinsk, in veins six feet wide, between chloritic schist and serpentine, as well as in a great many places in other parts of the world. At the Kelsey Mine, Los Angeles, Co. California, Ni. and Co. ores are found in the comparatively rare form of arsenates, together with silver-glance and native silver, in a fissure vein in close relation with a diorite dyke. The assorted ore contains 7 per cent. to 15 per cent. cobalt, 2 to 3 per cent. nickel, and 1,000 to 1,400 ozs. of silver per ton. Rich nickel ore has also been found in the Gem Mine, Fremont, Co. Colorado, in a hornblende schist, occurring as an arsenide and sulpho-arsenide, some of the specimens being so permeated with fine wire-silver as to be difficult to break. At surface the ores were mostly copper, but at a depth of 15 to 20 feet nickel was struck, and continued down to 75 feet, when the vein which had averaged $3\frac{1}{2}$ to 4 feet cut out and appeared to be lost, but, on resuming sinking, a streak of ore about 18 inches wide was struck, containing the same minerals and supposed to be a continuation of it, though this has not been definitely proved. Small shipments of this ore ran from 12 to 34 per cent. nickel, and 2 to 4 per cent. cobalt; the last lot shipped to England contained most of the nickel as niccolite. The ore streak is unfortunately narrow, the walls hard, and the ore difficult and expensive to mine. Nickel is known to exist in the hornblendic rock near Salida, Colorado. The serpentines of the west of Ireland and Cornwall, and indeed almost all serpentines contain a little nickel, and it is met with in Australia, New Zealand, and South Africa. Sufficient

has therefore been said to show that nickel ores are widely distributed over the world, though in the present condition of our metallurgical knowledge of the subject, payable deposits are less numerous than those of most of the common metals.

THE GENESIS OF NICKEL.

To explain the genesis of this class of ore deposits one must glance for a moment at the sources from whence nickel is derived. Native nickel is found alloyed with iron in meteorites, and also in some ultra basic lavas, whilst the spectroscope reveals its presence in the solar atmosphere. It is showered on the surface of our planet in the form of meteorites, those fiery messengers telling of the wreck of other worlds, and testifying to the common origin of the material universe, in the form of (1) holo-siderites composed entirely of nickel-iron; (2) syssiderites the nickel-iron of which contains silicates of magnesia and iron protoxide, identical with olivine, and at other times a mineral resembling augite; (3) Sporadosiderites, the most common kind, usually crystalline in structure, and containing nickel-iron, troilite, chrome-iron, olivine, titanite and phosphoric acids; (4) asiderites, distinguished by the presence of hydro-carbons in which nickel is present as an oxide. Some of them have been shown to contain pyroxene and felspar (chiefly anorthite) and the absence of quartz and highly silicated felspars is to be noted. These four classes of meteorites show a gradation from almost pure metal containing over 98 per cent. of nickel-iron to a stony mass closely resembling some basic lavas.

Now, according to the latest determinations of Mons. Alphonse Berget, "*Comptes Rendus*," July, 1893, the density of the earth is about 5.41, whilst, so far as our limited observation extends, that of the crust is about 2.5. Various theories have been advanced to account for this, and some very first-rate authorities have suggested that the heavier metallic elements might possibly be found to predominate in the nucleus, basing their views on widely extended observation of past and present volcanic phenomena.

It has been found that once the acid stage is past, lavas become more basic, and whilst each succeeding flow from any one vent might not be more basic than the preceding one, yet the tendency is in that direction till, finally, ultra-basic lavas are extruded from the centres of intense and long continued activity. This average order invariably, I believe, holds good

everywhere over the earth's surface, provided the volcanic force is long enough active. The ultra-basic rocks have in composition many points of resemblance to some of the above-mentioned meteorites.

Thus dunite is a crystalline granular aggregate of olivine and chrome iron, which passes by alteration into serpentine: we have also picrite, half of which is olivine, associated with hornblende, diallage, and magnetite. Lherzolite is another of these peridot rocks, consisting of olivine and enstatite, with other accessory minerals. Olivine is the dominant constituent of such rocks, and as a class they possess the highest specific gravity and least oxygen of any known.

Some of the basalts, notably those of Antrim in Ireland, contain metallic iron in microscopical particles, and Prof. Nordenskiöld discovered in 1870, on the shores of Disco, on the coast of Greenland at Ovik, fifteen blocks of nickel-iron within an area of half an acre, the two largest being 20 and 8 tons weight respectively; whilst further observations in the same locality showed that a basalt dyke, at no great distance from the supposed meteorites, contained lenticular disc-shaped blocks of precisely similar iron, and crystals of labradorite and arigite associated with viridite, round which minute particles of iron were moulded.

These facts led Professors Judd, Daubrée, and others, to decide that the blocks of iron Nordenskiöld discovered and took to be meteorites were of terrestrial origin, as the basalt was certainly not derived from the clouds.

The Ovik iron contains 0.5 to 6.5 of nickel, and a nickel-iron awaruite, lately discovered in New Zealand, presumed also to be of terrestrial origin, is said to contain 68 per cent. Ni., 31 per cent. Fe., and 0.7 per cent. cobalt.

In the Urals platinum is found alloyed with nickel-iron in association with olivine. Taking the mean density of awaruite as approximately 7.1, and that of rhyolite as 2.6; the terrestrial basic and ultra-basic rocks, which include basalt, gabbro, Lherzolite, trachite, and dolerite, are found to closely correspond in density with the extra terrestrial meteorites. Those of solid nickel-iron have a specific gravity of 7.1, and graduate down to stony siderites, which possess a density of 2.7.

	Meteorites.	sp. gr.
Nickel-iron solid		7.1
„ considerable		6.8
„ medium proportion		3.5
„ small quantity		3.1
Stony		2.7

Terrestrial metals and rocks.

	sp. gr.
Awaruite	7.1 approx.
Nickel-iron in Ovik basalt.....	6.8 „
Basalt, gabbro, Lherzolite..	3.0 to 3.5
Trachyte and dolerite	2.7 to 2.9
Rhyolite petro-silex	2.6

The conclusion to be drawn appears to be, that the genesis of nickel deposits may, in most instances, be traced to the ultra-basic rocks, and their derivatives, serpentines, and magnesian silicates. The great nickel deposits of the world are found in rocks in which olivine is the predominant mineral, whilst we have seen that olivine and the magnesian silicates are found not only in the ultra-basic rocks of the earth, but also in meteorites. Whilst these facts alone do not prove that the nickel was derived from the olivine, it is well to note the conditions under which the olivine was formed, and to see how far it is nickeliferous. Assuming a semi-metallic nucleus for the earth, and that in this nucleus iron and nickel are the predominant metals, as they are in meteorites, and allowing that the ultra-basic rocks came from the greatest depths in the earth's interior, under such circumstances, it would not be remarkable for silicates, crystallising out of the magma, to contain such metals.

From the microscopic study of the igneous rocks, much light has been thrown on the order of crystallisation of their component minerals, which has pretty definitely been proved to be fairly uniform. Thus the first minerals to form appear to be magnetite and ilmenite, sometimes chromite and picotite. Next come silicates, which occur in minute quantities, such as zircon and titanite; pyrite and pyrrhotine usually follow; and next the metallic oxides and sulphides, and the heavy, dark-coloured basic silicates, olivine, augite, and hornblende.

Olivine is the first of the rock-forming silicates to crystallise out of the basic magma. According to "Rutley," p. 117, olivine sometimes contains traces of titanite, phosphoric, and chromic acids, and the protoxides of nickel and cobalt.

Sandberger's experiments with rock silicates almost invariably show traces of Ni, Co, and Cu, from olivine and augite; whether the nickel occurs, as he supposes, in chemical combination, or, as A. W. Stelzner thinks, mechanically admixed, is practically immaterial to the question under discussion, it is sufficient to know that olivine contains the metal in quan-

tity enough to form, when dissolved and re-precipitated, rich and extensive deposits. We have seen, indeed, that the olivine in the Oregon rock gave 0.25 per cent. Ni, while the serpentine from Dillenberg showed 0.66 per cent.; and much of the serpentine in New Caledonia runs over 1 per cent.

A review of the foregoing facts certainly points to the conclusion that the nickel, at least of the serpentinous deposits, has been derived from the basic magnesium silicates of the original rock masses. As regards the nickeliferous pyrrhotite deposits, they may possibly have a different origin, as suggested by Vogt.

It has been proved that workable deposits of titaniferous iron have been probably formed in certain basic eruptives in Norway and Sweden, by a process of differentiation or segregation of the iron ore to the centre of the eruptive mass; and Vogt has suggested, and endeavoured to apply, the same theory, to account for the formation of the nickel sulphide deposits in the norites of Norway and Sweden and the Huronian deposits of Canada. As against this theory, it is remarked that the pyrrhotite deposits referred to occur along the contact planes of the gneiss and schists; and therefore, if they were formed by segregation from a molten magma, this process has taken place from the centre towards the outside, or in reverse order to that which characterises the iron ore and the supposed structure of the interior of our globe.

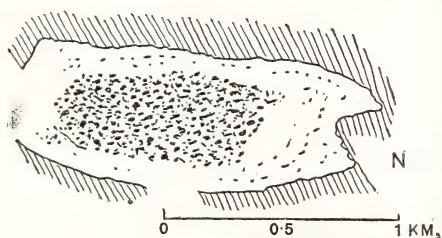


FIG. 3.—SEGREGATION OF IRON ORE.

Though there may be grounds for further investigation in this direction, these ore bodies would seem more probably to have been deposited from circulating mineral waters. Some geologists explain the presence of deposits of mineral, by supposing them to have been formed by the agency of circulating solutions bringing them to the surface from unknown depths, disregarding the fact that fissures have never yet been proved to have indefinite extension, nor can water circulate below certain limits.

Before, therefore, adopting an ascension theory for the formation of nickel deposits in basic eruptives, it is well to recollect that these rocks came from greater depths within the earth than circulating water is likely to have penetrated; much deeper in all probability than any vein-fissure could have extended to.

It is more rational, it seems to me, to suppose that the metals were brought within reach of surface agencies, and it is probably owing to the subsequent leaching of these basic eruptives that our principal deposits of nickel were placed at the disposal of the miner's pick. The practical lesson to be gathered from this is, I think, that the "prospector" looking for new deposits of this class, will best turn his attention to a field where rocks of this character are met with.

The progress of science day by day makes the art of mining less speculative and more business like, and it should be, I think, the function of the engineer to apply science to this legitimate commercial end; to raise it, in fact, into the position of an "industry," which has materially assisted in building up the prosperity of all new countries; which has done so for America already, and which will do so for our British colonies in the future, with marked advantage to us.

Mining supports tens of thousands of our population, opens outlets for remunerative enterprise and emigration, and exercises a civilising influence, which is world-wide, and, I think, the surest means to foster it is to point out its risks, as well as its advantages; to encourage the employment of necessary capital in profitable fields; and, equally, to discourage wasting valuable money on enterprises which do not possess the elementary conditions for achieving success. There are, in fact, three classes of people, I believe, who engage in mining: those who get most "metal" out of the pockets of the public, those who are content to mine in "pockets of ore," and those whose endeavour is to successfully develop valuable mineral deposits on what I would term a profitable commercial basis, with the aid of scientific knowledge applied practically.

The contracts for the metal in America closed early in 1892 were made at prices ranging from 55 to 60 cents per lb., these quotations being for metal of 98 to 99 per cent. fine. Later on, very good nickel of the same fineness has been offered at 52 to 54 cents, and at the close of 1892 could be bought for 50 cents. The dry process

has greatly tended to cheapen the cost of producing nickel, but this it must be recollected is off-set when there is a demand for metal of extreme purity, which can only, as yet, be obtained by wet treatment. This feature of the nickel confers a great advantage on the New Caledonian ores; to illustrate it, it may be stated, that the leading nickel refiners in the United States asked 70 cents per lb. for metal of first-class quality, whilst the price asked for the regular 98 per cent. grade was 56 cents prepared from the same ore.

In presenting you with these notes, I have to acknowledge my indebtedness to the papers of Mr. W. S. Austin and Mr. Ph. Argall, before alluded to, and I regret that the limits of this paper will not permit me to enter into the ore-dressing and metallurgical treatment of nickel. Both are subjects of special interest to mining men like myself, owing to the important place nickel may take in the future in many branches of the arts and engineering construction, provided only it can be produced at a more moderate cost than it can be placed on the market for at the present time; a necessary condition, which, in time, will certainly be attained.

I have to acknowledge my indebtedness to Professor Judd and Mr. Gregory for a series of specimens they have most kindly lent me to illustrate the rocks and ores I have referred to, which I shall be happy to show you at the conclusion of the meeting.

DISCUSSION.

The CHAIRMAN said he regretted that Professor Roberts-Austen was not present to take the chair, for he would no doubt have made some interesting remarks on the subject which he had made his own, viz., the influence of small quantities of foreign elements in metals. The paper opened a very wide field, including geological, mining, and metallurgical points of view.

Mr. GOWLAND said he had expected the subject would have been treated more from the metallurgical point of view, but the paper was a very valuable one, giving an exhaustive account of the distribution of nickel throughout the world, and entering also into some rather abstruse questions as to its origin and association with other minerals. He should like to ask if the production of the New Caledonian mines had been decreasing during the last two or three years, and also what was the cost of metallic nickel at the works where it was produced most cheaply. The metallurgy of nickel in this country had long been shrouded in mystery, manufacturers having kept their methods strictly secret, so that in most text-books the

information on this subject was of the most ancient character, representing in most cases the metallurgy of the metal as it was practised 50 or 60 years ago, if not earlier. As no information was given as to modern processes, he presumed this secrecy was still maintained. It seemed to him that the present uses of nickel were capable of a very great extension with regard especially to articles of pure nickel, not merely plated. Such articles would resist the action of London atmosphere, and also the acid, alkaline, and saline substances used in the kitchen, and if it were not for the rage for cheapness, it would probably displace both brass and copper for domestic utensils; being non-poisonous, it was especially suited for culinary purposes. He had not found the source from which the Chinese derived their nickel, but many of their old vases were made of an alloy of that metal and copper. This was not so in Japan; he did not think any nickel had been found there, and any nickel articles were always made of the Chinese alloy. Some years ago, when travelling in Corea, he found that both in China and Japan there was a large amount of German silver. Previous to that time Corea had been dependent for its white metal articles on China, but he then found they were made from German silver, or from nickel imported for the purpose of being alloyed. Four years ago the Japanese Government introduced a nickel coin similar to the American 5-cent piece, and of the same alloy, viz., 75 per cent. copper and 25 per cent. nickel, and some very curious results were obtained in making those coins. They began with the purest copper and nickel to be obtained, but with that there was the greatest difficulty in making the coins, but since they began to use copper prepared by refining old Japanese copper cash, which contained a small quantity of tin and lead—about 2 per cent. of tin and 5 per cent. of lead—they had no difficulty whatever, and he believed that impure copper was still being used. If German silver now formed an important import into China and Japan, it would tend to show that the old processes for the production of nickel alloys were more costly than those in use in Europe.

Mr. B. KITTO said they were much indebted to Mr. Charleton for this very exhaustive paper, embodying a vast amount of research, which would be invaluable to all students of the subject in future, and save them an immense amount of trouble. He should have liked to hear more about the deposits in North Carolina, which had lately come specially under his notice; he understood Mr. Charleton to say that one only of the series of deposits was likely to be productive on a large scale, but did not catch which it was. He had observed that the silicates of nickel and magnesium from New Caledonia, North Carolina, and Silicia, were very similar in composition and appearance, and was rather disappointed not to hear more about the metallurgy of the subject. He believed, at present, that even the silicates were brought into the form of matte, and he had frequently

found matte containing 60 per cent. of metal, but he could not help thinking that some other method for the treatment of these silicious ores might be adopted. He had hoped to hear something about Dr. Ludwig Mond's process which, he believed, was based on the curious fact that the metal at a rather high temperature entered into combination with carbonic oxide, forming a volatile substance which, when brought back to a lower temperature became dissociated, the carbonic oxide passing off as gas and leaving the pure metal. He believed the process was now being worked for the production of nickel of a very pure quality. The fact mentioned by the previous speaker that impure copper and nickel were more easily worked than the pure metals was a further illustration of the fact which Mr. Roberts-Austen had often brought before them, that small amounts of foreign substances had a very important influence on metals. Some years ago there was a considerable quantity of iron ore smelted in Australia, but it contained so much nickel that it was unsaleable, and he understood that the works had to be closed in consequence. Perhaps Mr. Charleton could say whether that was a fact, for if so, it seemed to him that those mines might be worked profitably now that the presence of nickel in steel was better appreciated.

The CHAIRMAN said he did not think it was necessary to associate the derivation of the name nickel with the hangman; the two metals, nickel and cobalt, occurred together, and the two names had, he thought, to a certain extent a common origin. Cobalt was named after the little gnomes, goblins, or elves who were supposed to inhabit German mines; the miner finding an ore which he supposed to contain silver, tried to smelt it, and when he did not succeed, he thought these little gnomes, or kobolds, had tricked him by putting into the mine something which resembled silver, but which would yield none. In the same way nickel probably owed its name to the German word *Nix*, meaning a water spirit, somewhat of the same nature as the kobold; and the term was probably given by the miner, and not by the metallurgist. With regard to the discovery of these new deposits in New Caledonia, and in Sudbury, he thought it was a mistake to suppose that prospectors were searching for them owing to the increased demand for the metal. Both were discovered by accident. Garnier, in New Caledonia, had his attention drawn to some green minerals, and tested them; he was not searching for nickel; and in the same way the Sudbury deposits were discovered accidentally, and were worked at first for copper, before the presence of nickel was known. He thought it was not good advice to the prospector to tell him to look for deposits similar to those with which he was acquainted; the miner should rather take it for granted that he would not always find deposits similar to those already known. If prospectors had confined their attention to known modes of occurrence, the diamonds at Kimberley and the gold at

Johannesburg would not have been discovered. Of course he might look for similar deposits, but he should not confine his attention to them; he must recollect that the unexpected very often happened. Lastly, he was sorry to find that Mr. Charleton had omitted to notice a very interesting little nickel and cobalt deposit in Wales, not now being worked, but which was worked on a small scale until quite recently. It was interesting for two reasons; first, because the two metals occurred in the form of oxides with a red clay and with brown iron ore in irregular deposits, being, in that respect, somewhat similar to the cobalt deposits in New Caledonia; and secondly, because the surrounding rock was totally different. The ore occurred in limestone, and there was no serpentine or olivine near. Another point of interest was that that little deposit was found not altogether accidentally, but owing to the care which a mining engineer took to test some small quantities of a black mineral found in the limestone. On testing it with the blow-pipe, he found cobalt, and that discovery led to the working of the mine. Having made these few and slight criticisms, he had much pleasure in proposing a hearty vote of thanks to Mr. Charleton for his very interesting and valuable paper, which, as had been said, contained a perfect mine of information for the student. Some disappointment had been expressed at not hearing more about the metallurgy of the subject, but he thought Mr. Charleton had done all he could in the time, and they might hope, on some future occasion, to have a further paper from him, dealing more with the mining and metallurgy of the ores of nickel.

The vote of thanks having been passed unanimously,

MR. CHARLETON, in reply, said the production of nickel ores in New Caledonia was certainly on the increase, in 1890 the production was 22,690 tons, and in 1891 35,000 tons. The lowest price at which it had yet been sold in America was 48 or 50 cents, and though the Americans expected it to come down to 36 cents, he thought that was rather a distant prospect at present. That was for ordinary 98 per cent. quality; that made by the wet process involved a higher cost. With regard to the North Carolina mines, the deposits occupying fissures, the strike of which was normal to the plane of division of the chrysolite mass, were considered likely to be most productive. He had heard recently something about the Mond process, which, he believed was being tried on a working scale in the States but he had not yet been able to obtain full details. With regard to the deposits of iron ore containing nickel, though the presence of the latter metal was a decided advantage in certain classes of steel, he did not think it could be considered so in iron; it made it "red short," especially with a low tenor of carbon, and therefore was extremely deleterious above a very small per centage. The Chairman's explanation of the origin of the name was probably correct. His intention was certainly not to suggest that the prospector

should confine his attention to any particular class of deposits; he knew the unexpected often happened, and the case mentioned in North Wales where the deposit of nickel occurred in limestone was somewhat parallel to one he had mentioned in the paper; the occurrence of millrite in calcite in Iowa, mentioned by him, p. 501. Of course, almost any statement with regard to mining must be made in more or less general terms; one could not dogmatise, and say that such a thing would always happen; the exception was always sure to turn up, and prove the rule. All he wished to point out was, that ultrabasic rocks, containing olivine, offered a likely field in which the prospector should look about him with the idea of discovering nickel, though such rocks might cover a large area and yield none.

Miscellaneous.

CASSAVA MEAL AND TAPIOCA.

Next to rice and sago, there are but few food products of a similar character that have such an extensive use as tapioca. And notwithstanding the enormous quantities that are produced, and the cheap rate at which it is sold in the English market, but little is generally known as to its origin and preparation.

Two distinct plants, though closely botanically allied, furnish tapioca; they are *Manihot utilisima*, *Pohl.* known as bitter cassava, and *Manihot aipi*, *Pohl.* the sweet cassava. The plants are natives of Brazil, where they are extensively cultivated, the bitter cassava especially, for the sake of the starch which is contained in the fleshy tuberous root, and which forms commercial tapioca. It is also largely grown in West tropical Africa, as well as in the Straits Settlements. It is a half shrubby perennial, with large leaves deeply divided into from three to seven, segments. The tuberous root often grows to a very large size, weighing many pounds, and containing a poisonous milky juice. The plant is known under a great number of varieties, differing in the colour of the stems and the division of the leaves. The roots of the bitter kind are said not to become soft by boiling or roasting, while those of the sweet cassava, though very tough in the centre, become soft by the application of heat; so that after being roasted or boiled, they are eaten in a similar manner to potatoes.

Besides tapioca, the cassava root furnishes several other valuable food products, as cassava meal and cassareep. In one of the monthly numbers of the *Bulletin* of the Botanical Department of Jamaica; these products and their uses are thus referred to. Cassava meal is prepared from both the sweet and bitter sorts, the root is grated, by which the cells containing the juice and starch grains are broken up, the grated material is placed under pressure, some-

times with water pouring through it. The pressure squeezes out all the juice, while a certain portion of the starch grains passes over with the liquor. The substance left under pressure consists chiefly of the cell walls broken up, but also of some starch grains. This is cassava meal, which is dried on hot plates, and made into cassava cakes. The liquor which passes away under pressure being the pure juice only, or the juice mixed with water, which is allowed to stand for some time, when the starch settles to the bottom, and the liquor is poured off. The starch grains, as seen under a microscope, are mullar shaped. This is cassava starch proper, as distinguished from cassava meal. Tapioca is prepared by heating moistened cassava starch on hot plates. This process alters the grains, which swell up, many bursting, and thus they agglomerate in small irregular masses.

Cassareep is the juice of the bitter cassava root, concentrated by heat, which also dissipates the volatile poisonous principle. The same is further flavoured with aromatics. Boiled with peppers, and fish or meat, it forms the West Indian "pepper-pot."

Cassareep is an article of import into England. It is a thick, black, treacly-looking substance, and forms a component part of most table sauces.

The following details for preparing cassareep, tapioca, and cassava cakes may be found useful:—"Grate the cassava, and squeeze out the juice, which is to be put aside for about three days; add one part of fine salt to every twelve quarts, and then boil down, until it becomes like syrup. If it is intended for long keeping, it must be boiled thick. Put aside in jars till required for bottling."

To prepare tapioca, "grate the cassava, wash it, by putting in a cloth, and pouring clean water on it till settled, and the water at the top is quite clear. Decant the water, leaving the starch at the bottom; wash again with clean water, allow it to settle, and pour off the water. Take up the starch in lumpss and put it to quail a little in the sun; then mash it up fine and sieve it. Put a large baking iron on the fire, and bake it in cakes, not too thick. The iron should not be too hot, as the cakes must not be baked brown. Then dry well in the sun, and beat in a mortar, coarse or fine, as required. If sieved, it will give two qualities, fine and coarse."

For making cassava cakes, the cassava should be grated, and well squeezed, but not washed. After squeezing, let the lumps dry very slightly in the sun. Beat on a mortar and sieve. Bake on the iron, thin or thick, according as the cakes are required.

General Notes.

PARIS PAPER INDUSTRIES EXHIBITION.—An International Book and Paper Exhibition will be held in Paris at the Palais de l'Industrie from 23rd July to 23rd November.

SILK TEXTILE EXHIBITION.—A National Silk Textile Exhibition of British and Irish Silks will be held at Stafford-house, St. James's (by permission of the Duke and Duchess of Sutherland). The Exhibition will be opened by H.R.H. the Princess Mary Adelaide, Duchess of Teck, on Tuesday, May 8th, at 3 o'clock.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock :—

MAY 9.—“Telegraphs and Trade Routes in Persia.” By COLONEL WELLS. SIR FREDERIC J. GOLDSMID, K.C.S.I., C.B., will preside.

MAY 23.—“Liquid Fuels.” By G. STOCKFLETH. SIR EDWARD J. REED, K.C.B., M.P., will preside.

MAY 30.—“Automatic Gem and Gold Separator.” By WILLIAM S. LOCKHART.

FOREIGN AND COLONIAL SECTION.

At Eight o'clock :—

MAY 29.—“Education in Victoria.” By Prof. C. H. PEARSON, M.A., LL.D.

APPLIED ART SECTION.

Tuesday Evenings, at Eight o'clock :—

MAY 8.—“Pewter.” By J. STARKIE GARDNER. PROF. W. C. ROBERTS-AUSTEN, C.B., F.R.S., will preside.

MAY 22.—“Decorative Art in connection with Elementary Education.” By SELWYN IMAGE, M.A.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock :—

HENRY CHARLES JENKINS, A.M.Inst.C.E.
“Typewriting Machines.” Two Lectures.

LECTURE II.—MAY 7.—Requirements that a Type-writing Machine should meet—Later attempts to satisfy these—Type-bar and Type-wheel Machines—Keyboards and change of “Case”—Alignment—Supply of Ink to Type—Inspection of the Writing—Spacing of the Letters—Stenographic Machines.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 7...SOCIETY OF ARTS, 8 p.m. (Cantor Lectures.) Mr. Henry Charles Jenkins, “Type-writing Machines.” (Lecture II.)

Meteorological, Sanitary Institute, 74A, Margaret-street, W., 8½ p.m. Dr. C. Theodore Williams, “Climate in Relation to Health and Geographical Distribution of Disease.”

Engineers, Town-hall, Westminster, S.W., 7½ p.m. Mr. R. Nelson Bond, “A Deep Boring near Freistadt, Austria, by the Canadian System.”

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. Claude Vautin, “The Commercial Electrolysis of Fused Salts.” 2. Messrs. W. H. Stanger and Bertram Blount, “Testing of Hydraulic Cements.”

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Lieut.-Col. H. A. Sawyer, “The Bakhtiara Mountains and Upper Elam.”

Inventors' Institute, 27, Chancery-lane, W.C., 8 p.m. British Architects, 9, Conduit-street, W., 8 p.m.

Annual meeting.

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m.

Surgeon-General Gordon, “Chinese Philosophy.”

TUESDAY, MAY 8...SOCIETY OF ARTS, John-street, Adelphi, London, W.C., 8 p.m. (Applied Art Section.) J. Starkie Gardner, “Pewter.”

Asiatic, 22, Albemarle-street, W., 3 p.m. Annual meeting.

North-East Coast Institute of Engineers and Ship-builders, Newcastle-on-Tyne, 8 p.m.

Royal Institution, Albemarle-street, W., 3 p.m.

Prof. J. W. Judd, “Rubies—their Nature, Origin, and Metamorphoses.” (Lecture II.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. William Colquhoun's paper “The Manufacture of Briquette Fuel.” 2.

Mr. Andrew Brown, “Recent Types of Ferry Steamers.” 3. Mr. William Carson, “The Birkenhead Ferryboats, *Wirral and Mersey*.”

Photographic, 50, Great Russell-street, W.C., 8 p.m.

Mr. C. H. Bothamley, “Permanence of the Undeveloped Image on Gelatino-bromide Plates,” and “The Standard Amyl-acetate Lamp, and some other forms of Constant Light.”

Anthropological, 3, Hanover-square, W., 8½ p.m. Colonial Institute, Whitehall-rooms, Whitehall-place, S.W., 8 p.m. Sir Charles Tupper, “Canada in Relation to the Unity of the Empire.”

WEDNESDAY, MAY 9...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Colonel Wells, “Telegraphs and Trade Routes in Persia.”

Geological, Burlington-house, W., 8 p.m. 1. Mr. Alfred Harker, “Carrock Fell: a Study in the Variation of Igneous Rock-masses.” Part I, The Gabbro. 2. Messrs. A. M. Davies and J. W. Gregory, “The Geology of Monte Chaberton.” 3. Mr. J. W. Gregory, “A Bagshot Outlier on the Corallian at Highworth, in North Wiltshire.”

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

Patent Agents, 19, Southampton-buildings, W.C., 7½ p.m. 1. Mr. Lloyd Wise, “The Present Position of the Profession.” 2. Mr. C. D. Abel, “The True Position of Patent Agents Relatively to Inventors.” 3. Mr. P. Jensen, “The New Patent-law of Denmark.”

THURSDAY, MAY 10...Royal, Burlington-house, W., 4½ p.m. Antiquaries, Burlington-house, W., 8½ p.m.

Meteorological, Sanitary Institute, 74A, Margaret-street, W., 8½ p.m. Mr. F. Gaster, “Fog, Clouds, and Sunshine.”

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Dewar, “The Solid and Liquid States of Matter.”

Electrical Engineers, 25, Great George-street, S.W., 8 p.m.

Mathematical, 22, Albemarle-street, W., 8 p.m.

FRIDAY, MAY 11...United Service Institution, Whitehall-yard, 3 p.m. Capt. S. P. Oliver, “Recent French Operations in Western Africa.”

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Rev. S. Baring-Gould, “English Folk Song.”

Astronomical, Burlington-house, W., 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Science Schools, South Kensington, S.W., 5 p.m.

SATURDAY, MAY 12...Royal Institution, Albemarle-street, W., 3 p.m. Captain Abney (Tyndale Lecture), “Colour Vision.”

Journal of the Society of Arts.

No. 2,164. VOL. XLII.

FRIDAY, MAY 11, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CONVERSAZIONE.

The Society's *conversazione* is fixed to take place at the Imperial Institute, South Kensington (by permission of the Executive Council), on Friday evening, June 22.

Each member will receive a card for himself, which will not be transferable, and a card for a lady. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member.

Further particulars as to the arrangements will be given in future numbers of the *Journal*.

CANTOR LECTURES.

Mr. HENRY C. JENKINS, A.M.Inst.C.E., delivered the second (and last) lecture of a course on "Type-writing Machines" on Monday evening, 7th inst.

On the motion of the CHAIRMAN (Mr. Francis Cobb) a vote of thanks was passed to the lecturer.

The lectures will be printed in the *Journal* during the summer recess.

Proceedings of the Society.

INDIAN SECTION.

Thursday, April 26, 1894; Sir STEUART BAYLEY, K.C.S.I., C.I.E., in the chair.

The paper read was—

MUNICIPAL AND VILLAGE WATER SUPPLY AND SANITATION IN THE NORTH-WEST PROVINCES AND OUDH.

BY SIR AUCKLAND COLVIN,
K.C.S.I., K.C.M.G., C.I.E.

The needs and difficulties of sanitation, which is the Cinderella of the Indian admini-

strative family, have on two previous occasions been brought before this Society. At its meeting of January 27, 1888, Sir Henry Cunningham read an interesting paper on the "Public Health in India;" and on March 3, 1892, Surgeon-General Sir William Moore addressed the Society on "Indian Sanitation, and the International Congress of Hygiene." Meanwhile, in August, 1891, the Indian Section of the Seventh International Congress of Hygiene and Demography had, under the presidency of Sir Mountstuart Grant Duff, assembled; and the valuable essay on "Sanitary Progress in India," by Sir William Moore, with other contributions by various authorities, have been collected in Volume xi. of the "Transactions" of that Congress. All these papers agree in drawing attention to the vague designs, the unfinished outlines, and hesitating touches of the Indian sanitary artist. Since the above dates, however, and notably since 1888, very important steps have been taken by the Government of India in the promotion of sanitation. What those steps have been, and what effect has been given to them in that section of the Upper Provinces which may be historically spoken of as Hindostan, it is the purpose of this paper to describe.

Before doing so, let me say a word as to my reasons for limiting this paper, though at the risk of forfeiting the interest which attaches to a larger field, to one province only. I have done so, in the first place, because it is the Province with which I am especially familiar. My object is to assist in bringing up to date, from authentic sources, information as to the present state of sanitary reform, in the hope that others competent may furnish similar information for other Presidencies and Provinces, rather than to give a general, and, therefore, a more superficial sketch of the advance of sanitation since 1888, in India, taken as a whole. When this Society again reviews the needs of Indian sanitation in the various presidencies and provinces, it may thus have before it a complete account of the situation at that time existing. The other, and to my mind, the not less important reason has been that on sanitation, as on many other points, discussion which deals with India as the unit can rarely be profitable. Few expressions have led to greater confusion, or have been the cause of more mischievous fallacies, or dangerous proposals, than the use, or misuse, of the term India, as predicating a collection of countries, peoples, and problems of administration,

assumed to be identical in nature and in circumstance, because covered by a common geographical label. Not a year passes but we see India and Indians spoken of, and efforts made to deal with them, as though because all are alike Indians, therefore all are Indians, and alike. But the Spaniard, in character, history, language, religion, does not differ from the Englishman, or the Scotchman from the native of Naples, more than the Mahratta from the Bengali, the Ooriya from the Hindustáni, or the Madrasi from the Sikh. The unit of discussion, as of administration, is the Province. The sanitary aspects of the country called India differ, in its several Provinces, no less and no more than their ethnical, lingual, or climatic aspects. When on this fallacy in terms, are put forward schemes which, in the conduct of British administration, would constrain the native of one such Province to the jurisdiction and rule of another, because both are assumed to be natives of India, in the sense that we are Englishmen of England, or Scotchmen of Scotland, it is time to insist and to resist. Therefore, whether it is sanitary or (with rare exception) another branch of administration which is discussed, I would say—Discuss it by province, by presidency, by whatever limits of locality you find most suitable. But, if you wish to avoid mischievous generalities, if you wish to abstain from useless controversy, and if you hope—as one may hope—to assist in ultimately removing, or (for the immediate present) in shaking the base of many impracticable, and of some dangerous proposals, avoid so far as it may be avoided, making India the field of your experiment, and limit yourself to one or other of the several provinces to which that title is, geographically, applied.

It has been said—and, after this digression, it may be necessary to repeat—that it is the object of this paper to indicate the several sanitary reforms enumerated as necessary in the discussion here in 1888; to explain the scope and aim of the instructions issued since then by the Government of India in the course of that year; and to illustrate the outcome of those instructions by stating what have been the measures put into force in pursuance of them in the North-West Provinces and in Oudh. The subject divides itself into Water Supply and Drainage: and each of these again into Urban and Rural. Under these heads will be shown what has been the aim of the provincial efforts; the limits within

which they have been restrained; the considerations by which they have been guided; the legislative measures which have been adopted to give effect to them; and the experience which has, so far, been obtained.

The first proposal, cited by Sir Henry Cunningham in his paper of January 27, 1888, was one put forward by the Royal Commission appointed in 1859, to consider army sanitation in India, viz., to appoint in each presidency a central authority to advise, to direct, to supervise, and, under the sanction of the local government, to control. "It should be prepared"—I quote Sir Henry's paper—"to give to all municipalities the necessary help and guidance; to scrutinise all new projects; or, when asked to do so, to supply competent engineers, who would furnish schemes of drainage, water supply, and other sanitary improvements." The next proposal was to promote facilities for scientific research and experiment; and, therefore, to create a staff sufficiently able and numerous, and provided with the necessary resources, to conduct scientific investigations into disease with all the precision and completeness necessary to such inquiries. The third point was that the Government of India should provide loans for sanitary purposes at moderate rates. The fourth and last was that sanitary education should be promoted in schools; and that, before proceeding to India, gentlemen who have passed the competitive test of the Civil Service should be called on to acquaint themselves with some of the elementary facts connected with the public health. Sir William Moore similarly called attention to the necessity for Government loans; and expressed himself in accord with those whose motto, in this matter, would be *Festina lente*: and who are willing rather, for the present, to trust to the usefulness of guidance, encouragement, and instruction, than to have recourse to undue interference, or to clamour for official pressure.

As to the first proposal—the central authority—the Government of Lord Dufferin, in a comprehensive Resolution (as papers of that kind are called in India), dated July 27, 1888, desired the several local governments to constitute Sanitary Boards within their jurisdictions, primarily for supervision and for advice, and for such degree of immediate control as might in each case be thought advisable. But before this Resolution appeared, an engineer, especially qualified for the task, had been selected and nominated, in the North-West Provinces and Oudh, in the

commencement of 1888, for the especial duty of advising municipalities which were anxious to adopt schemes of water supply or of drainage, of preparing schemes, and of superintending their execution. Mr. Hughes, a member of the Institute of Civil Engineers, and at the time on the engineering staff of the provincial government, was the officer happily selected; and to him is due the sole credit of having prepared and controlled the execution of the great water works, and of having planned the greater drainage works in the chief cities of the province. By his appointment, that want of confidence in their advisers, hitherto felt by municipalities, which is indicated by Sir Henry Cunningham as a fertile source of delay and disappointment, was effectively remedied. The local municipalities which profited by his services have divided between them the charge of his salary; and his several schemes, after being accepted by the municipality concerned, and examined by the Government adviser, and in some cases by Mr. Baldwin Latham, whose name as a sanitary engineer of eminence in England will be known to you all, have finally been adopted and put into execution.

Effect was given in 1889 to the directions of Lord Dufferin's Government by the creation of a Sanitary Board in the North-West, as in other provinces. Its functions in the North-West Provinces are consultative mainly, and its duties those of collecting and digesting information and of conducting inquiry, rather than the discharge of direct executive duties, which remain under the Government, in the hands of district officers. Such a Board is necessarily composed of various officials, brought from time to time round a common table, but each having his own prescribed work to perform, and separated from one another, on tour, or at their several centres of employment, during many months of the year. Such a body has good opportunities of gathering information, and, when its members meet, of discussion. But if useful in counsel, it is clumsy in execution; it is at its best in consultation, at its worst in despatch. The Sanitary Commissioner has been its most active member; the Sanitary Engineer is now its secretary, and at the same time the executive officer of the Government in carrying out measures decided on within his sphere of action. Irrigation officers, district officers, the medical service, and finance are alike represented in it. The Board has now entered into the fifth year of its existence,

during which it has occupied itself with such matters as projects for the drainage of tracts waterlogged from excessive canal irrigation; the improvement of birth and death registration in towns and villages; the application of sanitary measures to rural tracts, and the legislation necessary to give effect to them. It will not, of course, be supposed that the fabric of the Central Board is as yet consolidated by time; or that it has arrived at the utmost uses of which it is capable. Far from it. As time passes its functions will be modified, and the area of its duties enlarged. Meanwhile it is there, and at work as the necessary central authority contemplated by the Royal Commission; on the one hand a capable guide to the district officer, on the other a competent adviser to the Government. Without funds its labours would be mostly academical; and it will be presently shown what has been done to furnish municipalities and rural tracts with funds.

As to the promotion of facilities for scientific research and experiment, which was the next recommendation put forward in 1888, the selection in England and the appointment in 1892 of Mr. Hanken as Chemical Examiner at Agra, is the first step in a new departure which, in the course of time, should yield very valuable results. The post of Chemical Examiner has been hitherto usually held by a medical officer on the provincial staff; but the time had come when it was desired to select an expert especially qualified by training and by repute for the conduct in the Upper Provinces of scientific investigations and experiments into the origin and growth of the germs of the diseases most prevalent there. Mr. Hanken (an eminent pupil of Pasteur) was selected by the Secretary of State; and on his arrival arrangements were made, under his guidance, for building a proper laboratory at Agra, where he will, by degrees as funds and circumstances permit, form for himself a staff, and which will be the headquarters of his operations; though the more temperate climate of the Himalaya may, in the summer, be necessary to the success of his investigations. The growth of scientific research in the North-West and Oudh must be in great measure the work of Mr. Hanken's own very capable hands, whose chief difficulties will possibly lie in the command of sufficient funds. In the Agra Medical College may be found means of preparing a staff qualified to aid him in the less delicate operations.

The third point indicated by Sir Henry Cunningham was that the Government should

provide loans for sanitary purposes at moderate rates. The difficulty about funds—which was, in truth, the one insuperable difficulty against which municipalities had, in older days, to contend—was overcome shortly after the issue of those instructions of July 27, 1888, which have been referred to. On the auspicious date of New Year's day, 1889, indicating at the same time its desire that the rules should take effect from April, 1888, the Government of India laid down the procedure under which, for the first time in their history, provincial governments were empowered to advance to municipalities, or to other bodies, funds needful to their purposes. The substance of the rules then promulgated, and since in force, is that loans shall be granted only to works in which the Government, apart from mere local interest, has a general interest, such as drainage and water-works; such loans to be repaid within as short a period as possible, not exceeding 30 years in any case, or 20 years except under very special circumstances, and with special sanction. The Government of India annually, since 1889, has allotted to provincial governments, at 4 per cent., sums for this purpose, varying with the requirements of the province, its own requirements, and the amount of its cash balances. The North-West Government has lent part of such sums annually to the municipalities engaged in water work or drainage schemes, first at $4\frac{1}{2}$ per cent., but later at 4 per cent., it having been found that the cost of establishment, to meet which $\frac{1}{2}$ per cent. had been added, was too small to warrant any special charge; $1\frac{1}{2}$ per cent., in round figures, is added for sinking fund, the loans being extinguishable in 30 years. Since 1890 the annual loans thus placed in the North-West Provinces and in Oudh have ranged from 11 to 15 lakhs, if I remember rightly; and it may be affirmed beyond all contradiction that, without this direct financial aid from the Government, not one of the sanitary works which have been undertaken by municipalities since January 1, 1889, could possibly have been put in hand.

As to sanitary education in schools, I cannot speak with much confidence. There are text-books and primers, but where teachers are indifferent or ignorant, scholars cannot be expected to learn. The subject is kept in view by the Educational Department; and, possibly, the recent extension of sanitary works in the larger cities may gain it more popular attention. Personally, I scarcely venture to hope this. Natives of the North-West

Provinces will take advantage of any and every convenience provided for them; but they do not reason as to the why or the wherefore of the schemes which provide them. They will drink pure water without studying the laws of health, as they will crowd, one caste with another, into a railway carriage, without informing themselves as to the social uses of travel. Moreover, before advanced text-books on sanitation in Upper India are compiled, many practical questions must be settled, which the application there of sanitary principles, as accepted and enforced in Great Britain, has brought and will continue to bring into dispute.

This brief review will show the steps which, in the last six years, have been taken to provide machinery for execution and control, and funds for carrying out sanitary works in the Provinces concerned. The next object of this paper is to state what have been the measures actually adopted, whether as to urban, or as to rural sanitation and water-supply.

Before stating this, it will be well to glance at the general conditions of the province from a sanitary point of view. The cities lie in flat alluvial plains, those with which we are at present concerned being watered by the Ganges, the Jumna, or the Gumti. Water-power in these cities is therefore amply available, but there is very little natural outlet for drainage except by recourse to the rivers. Their population is, as usual in the East, crowded, though in varying degree. The density of population per acre in Cawnpur city is 187, in Agra 150.32, in Benares 101, in Allahabad 63.72, in Lucknow 46.47. Take, for comparison, London, where it is 56 only; or Liverpool, where it is 113.8. (If, in this paper, overcrowding, and the great need of opening out more space in the fetid towns, has not been dwelt on, it is because it is outside my immediate object. Here, again, great sums are needed; but, at least, it can be said that not one of these cities is without large pleasure grounds, open to the public, and used by them.) The population of the five cities with which we are immediately concerned, is little over a million: Agra, including its cantonments, numbering 168,708; Allahabad, similarly, 176,872; Cawnpur, 182,315; Benares, 222,523; Lucknow, 273,087. The total population of the provinces of Oudh and the North-West being in round numbers 47,000,000; these five principal cities furnish but little more than 2 per cent. They number, on

the other hand, about 28 per cent. of the municipal and 16 per cent. of the urban population. But they must not, for a moment, be judged by the test of their resident population only. Two amongst them, Benares and Allahabad (to the Hindu known as Kási and Prág), contain all that, in his eyes is most holy; and in thousands upon thousands, from all parts of the peninsula, pilgrims and devotees stream all the year round to the sacred Kási, on the banks of the no less sacred Ganges; or to that sandy spit beyond the green mango groves and the tiled roofs of Prág, where, at the alleged junction of the three rivers, the Ganges, the Jumna, and the fabled Saraswati, especially at the annual gathering in January, hundreds of thousands bathe in their cleansing waters. Lucknow furnishes its capital city to an important province, and is the social centre of Oudh, to which all the wealthy landed proprietors and the great Talukdars repair at frequent intervals, with their numerous retainers, or in which they reside for many months each year. Cawnpur is the chief mercantile city of Upper India; and Agra, now a busy commercial centre, because situated at the junction of many converging railway lines, has since the days of the Emperor Akbar been a favourite resort of Mahommedans, second only in traditions to her sister Delhi. There is, therefore, between all these cities, especially between Benares and Allahabad, constant and sensitive touch with all parts of India. If cholera prevails in Kási, it will presently march, with the pilgrims whom it accompanies, to Jeypur; the putrid well of Prág will poison the trader making up his accounts at Nagpur; the open drain of Cawnpur will breathe death into the bazaar of Lahore. There is no city, no village, no hamlet, no house in all India, whether Hindu, Mahommedan, or Christian, which is not deeply interested in the sanitation of the two great pilgrim cities; and in a lesser degree of the other three great towns.

What the condition of the water-supply and sanitation of these great cities has hitherto been, it is, I think, unnecessary to remind you. Wells, many of them in a state of neglect—wells used for bathing, into which the waste water in part returns—wells situated in the heart of crowded buildings: wells, of some of which the water in summer is half filth and mud, and which, in the rainy season, receive through their gaping sides the poison from the soakings in of the drainage lines which

cross and recross them, are the chief sources of their drinking supply. River water has been hitherto sold in the streets and lanes of Agra and Lucknow, unfiltered, and full, in the summer season, of sand and decayed animal and vegetable matter. Analyses of the well-water in each of these cities has proved that during many months of the year few wells are fit for human use, while some are at all times poisonous. In spite of constant attention, mortuary statistics are still somewhat imperfect in these as in other cities of the provinces concerned; but imperfect as they are, and they are in any case not under the mark, they show in the decade from 1882 to 1892, mortality in Agra varying from 29 to 48 per mille; in Allahabad from 23 to 38; in Benares from 32 to 52. The Cawnpore death-rate is rarely under 50 or 60 per mille; the Lucknow rate between 40 and 50 per mille. The drains are either surface drains; or (as in Benares) masonry drains practically open, laid just below the soil, and washed only in the rainy season. There is more to be said about these presently. The rural population form the mass of the people in the provinces under review; 41,600,000 in round figures, of a total of 47,000,000. Their pressure on the soil varies as greatly as the soil itself. On the eastern frontier, but little outside the tropics, with water nearer the surface, and a heavier rainfall, they are 654 to the square mile; in Oudh they are 510; in the dry central districts such as in sandy wind-swept Mainpuri they are 448; in the districts southwards across the Jumna from 260 to 220 only. This exceeding great population is scattered over 106,000 villages, and 241,194 inhabited sites, of every size and character: from the great flat-roofed dried-mud village of the Meerut Jat, two miles or more distant from its neighbour, perched on its little eminence among its mango groves, and looking like a walled strong place, to the little groups of red-tiled huts, scattered here and there throughout the village area among the green fields, by the side of well, or water, or under the shade of the thick-clustering bamboos, in the eastern district of Goruckpur. The average population of these inhabited sites is 194. It is these rural tracts, this innumerable firmament of hut and hamlet (the village houses numbering over 7,000,000), scattered over a total area of 112,612 square miles, where no eye can hope at all times to see, no hand to penetrate—whose millions call for sanitary

aid, but whose poverty makes it impracticable—which are the despair of the sanitary reformer. They lie for the most part on the flat land, or little raised above it, scorched alternately by sun, searched by fiery winds, or drenched by continuous rain, in entire disregard of all sanitary care; their occupants drinking from the pond in which they bathe, and in which their cattle wallow; surrounded by the refuse of their daily lives; far from the frequent eye of the English officer; and, if coerced at all into cleanliness, to be coerced only by the ever itching palm of the underling, or by native officers, little less opposed than themselves to the rigour of sanitary regulations.

With this brief review of the chief urban and rural population, we may pass to the measures which have been undertaken in the cities since, in 1888, the Government of Lord Dufferin resolved to set its house in sanitary order. It is not possible to enter in this paper into much technical detail of the work accomplished. Such a general description must suffice as will convey to this Society the character and the extent of the work done, the outlines of the work to be accomplished, and the chief problems which have forced themselves upon attention.

Since 1888, the cities of Agra, Allahabad, Benares, Cawnpur, and Lucknow have successively undertaken and completed extensive schemes of water-works, filtered water being first distributed in Agra in December, 1890; in Allahabad in March, 1891; in Benares in November, 1892; in Cawnpur last month; while in Lucknow, I believe, the opening is fixed for some date in the first half of this year. For some years prior to 1888, the municipalities of Agra, Allahabad, Benares, and Lucknow had been engaged in attempts to solve the problem of their water supply; but the want of qualified engineers to advise, and the financial difficulty, stood in the way of progress. In all five cities the general features of the scheme are alike; though in Cawnpur and in Benares, where drainage and drinking-water schemes are combined the works are of greater extent. In all cases water is pumped at a selected position above the city from the contributing river to settling tanks, whence it passes into filter beds, and ultimately, into a clear water reservoir. From thence it is taken up by a second set of engines and distributed in the city by means of mains and stand-posts. The amount distributed varies at present according to the popularity of the

water; the estimated amount may be taken at a minimum of 2,000,000 gallons, to a maximum of 4,000,000 gallons daily; but at present the water daily distributed in no case, I believe, exceeds 1,250,000 gallons. The daily consumption, apart from water for flushing surface drains or road-watering, is estimated at from 10 to 15 gallons per head in the native city, and 20 gallons among English residents. All parts of each city are not as yet included in the water distribution, either because, as at Lucknow, some parts lie across a river, or because, as at Benares or Agra, some are situated at so great a distance from the distributing centre that, before they can be included, the financial outcome of the scheme must be awaited. Of the five cantonments (for at each of these cities there is a very considerable English and native force); all have, Benares excepted, availed themselves of the municipal scheme. It is, I presume, the consideration of distance which at present deprives Benares cantonment of pure water.

As to the *technique*, take the outline of the scheme at Allahabad, as applicable, *mutatis mutandis*, to all five cities. The works at the inlet station on the Jumna consist of an inlet or suction-well and an engine-house. The former is sunk 27 feet below low-water level; and three pipes, 24 inches in diameter, are laid from the well to the slope of the river bank at different levels. These are fitted with sluice valves, so that only one of them, whichever is the least submerged, is worked at one time. Two pumping-engines, each capable of raising 2,100 gallons per minute, are provided for raising the unfiltered water, which is conveyed from the engines on the river to the settling tanks, a distance of about three-quarters of a mile, through a 20-inch main, discharging 2,100 gallons per minute. Each engine is capable of discharging 2,016,000 gallons in a day of 16 hours, and 3,024,000 gallons in a day of 24 hours. The works at the settling tanks comprise three settling tanks, each with a working capacity of about 2,800,000 gallons; five filters, each 20,000 square feet in area; and a clear water reservoir with a capacity of 2,500,000 gallons. Two pumping-engines are provided for the distribution of the filtered water, each capable of raising 4,000 gallons per minute. There are over thirty miles of mains and extension pipes, and about 240 stand-posts. It is the aim of the municipality to have a stand-post within 600 feet of each house comprised within the radius of the system.

The schemes have in all cases been sub-

mitted to the approval of the medical authorities, and have been worked out stage by stage in close consultation with the Sanitary Commissioner, Surgeon-Major Hutcheson, whose criticisms and suggestions have been no less invaluable than his zeal in the prosecution of works which have appealed so strongly to his professional sympathies. It may be added here, that at the Hill Sanitaria of Almorah, Naini Tal, and Mussooree water-works, on a smaller but on a considerable scale, have been carried out by their respective municipalities.

The gross capital cost of all the above schemes, including the drainage schemes of Benares and Cawnpur, is estimated at not less than 112 lakhs; but deducting grants in aid from the provincial government and sums obtained from other sources, the net charge to be met from municipal resources is taken at 83 lakhs. The annual charge for interest at 4 per cent., with sinking fund in round figures at $1\frac{1}{2}$ per cent. (the debt to be extinguished in 30 years), with deductions made for economies of establishment consequent on the introduction of the schemes, and for sale of water for garden purposes, is about R 540,000, or, roughly, an average of 1 lakh annually to each of the five large municipalities, or 8 annas per head per annum of the population. To meet this it has been found, of course, necessary to increase taxation; and the total incidence of taxation—old and new—is estimated to vary from three annas per head per annum in the poor city of Lucknow to one rupee per head per annum in the wealthy centre, Benares. The additional funds, so far as they are raised from residents within municipal limits, have been met in some cases from readjustment of octroi duties, in others by house rating, in some, again, by both; in Cawnpur octroi has been recently introduced, but is about to be rejected in favour of a system with which I am not well acquainted; while in Benares means are being devised to cause the pilgrims, who resort in immense numbers to that city, and for whose safety water and drainage are largely designed, to contribute, and to lessen the incidence of the taxation on the permanent residents. The payments made by the several Cantonments for the use of Municipal water form also a very important item of receipt.

The consumption of filtered water is steadily on the increase; house connections are being established in considerable numbers; and though here and there the orthodox may prefer to fill his stomach with sand and vegetable matter from the Ganges direct, or the priest

may bathe himself and his little arrangement of gods from the putrid flow of cesspools, disguised as wells, the masses take readily to the new supply. It is too early yet to quote figures illustrating its effects on public health, but if there is any truth in the conclusions of sanitary science, and any value in the analogy of Calcutta or Bombay, we may predict the result.

With the creation of a good water-supply has been associated a survey of all wells in the city limits, and an analysis of their water. Some have been closed; some have been repaired; many still await examination. In Benares, and possibly elsewhere, where houses are in some parts interspersed with fields or gardens, the same well is often used for drinking or for irrigation. It will be impossible to close such wells. It has been found that the plentiful supply of water has necessitated, notably in Agra, the need of more complete surface drainage. Standposts have been erected in unpaved lanes, where wasted water collects, and, mixed with sullage water, becomes stagnant. The paving of all such lanes, and the provision of side drains, has become imperative; and must, in future, be accepted as part of the initial cost of a water scheme.

In Cawnpur and in Benares extensive drainage schemes have been prepared by Mr. Hughes, modified by Mr. Baldwin Latham, and eventually accepted by the municipalities. Space will not allow me to describe these great drainage schemes at length, which, though in hand now, will not be completed, owing mainly to questions of ways and means, possibly for four or five or more years. It must suffice to say that each city being divided into areas *ad hoc*, and a system of general house connections for sewage being premature, the scheme provides for the connection of the public latrines with the sewers, and for the removal of refuse matter from private houses, in pails, to central points, called pail depôts, whence it is driven by water from the mains into sewers. The side drains will be freely flushed, the water being carried off into the sewers, and bathing platforms will be erected at various points, for public convenience. The disposal of the sewage (which at present is partially discharged into the Ganges, partly disposed of on the trenching system, and in part, I fear, undisposed of all, except by evaporation and slow decomposition)—the future disposal of the town sewage is the point of difficulty, and on this head it is necessary to say a few words.

When dealing with the drainage of Cawnpur,

Mr. Baldwin Latham expressed himself as follows :—

“In these estimates no provision has been made for purifying the sewage before turning it into the river, and in my judgment, sooner or later, the question of purification may have to be faced. I am of opinion that the turning of sewage into a large river like the Ganges, has never been attended with any evil results to health; yet I am convinced such mode of disposing of sewage is repugnant to the senses; and hereafter, when it is found necessary to deal with the sewage, then the best mode of disposing of it will be by applying it to land.”

Again, in reporting on Benares, he wrote :—

“I am quite aware that the objections to running crude sewage into a quick-flowing river of large size are more sentimental than real, and in no case within my knowledge has any bad result occurred to the health of those living on the banks of a slightly polluted stream, or has the water, taken from a river receiving sewage after a fairly long flow, ever been proved to be the cause of disease. On the other hand, we have the actual experience that the flow down a river will destroy germs of disease; and it is a well ascertained fact that no rivers are entirely free from the direct or indirect influence of sewage, and yet it is well known that the inhabitants of all towns supplied from such rivers are more healthy than those of similar towns receiving their water-supply from impounding reservoirs, deep wells, or other sources.

“The removal of the sewage from the Ganges will not free the river from the most objectionable impurities, for it will always contain the remains of thousands of partly-burnt bodies, and the unburnt bodies of all persons dying of cholera or small-pox, and of unmarried children under twelve years of age, and the bodies of certain religious ascetics; while bathing, ablution and washing of all soiled clothes take place directly in it and its tributaries; to which add the pollution arising from navigation, and we have a formidable amount of unavoidable pollution.

“Compared with the flood volume of the Ganges, the whole of the impurities that can be put into it are infinitesimal, and the provision of Nature in the living waters of an ever-flowing stream are so great as to destroy, in the course of a few miles’ run, any dangerous impurities passed into it.”

The question of the disposal of the sewage of these Indian cities admits, in my judgment, of further inquiry before it is assumed that the river must be abandoned, and the sewage farm established. There seem to me grounds for contending that, with the great amount of water available in India, and the comparatively small amount of sewage disposed of, the risk of poisoning the river would be minimised, even though the existing system of discharging into the river were enlarged.

The rural population in the neighbourhood of the Ganges and Jumna—for it would be incorrect to speak of any such population as lying on their “banks”—with very rare exceptions, does not, it has been ascertained, drink river water. Great towns are at great distances apart. To expose the neighbourhood of a large city in Upper India to the proximity of areas inundated with liquid sewage, even partially defecated, seems to me a very hazardous proceeding. However, a strong mixed committee, which was convened in November, 1893, by the Government of India to consider the question, has reported in terms which will probably dispose of the matter for, at least, the present. They say—

“The Committee, having carefully and specially considered these points, arrived at the following conclusions, which were unanimously adopted :—(a) That where water is available and abundant, it is desirable to dispose of both solid and liquid sewage of towns and cantonments by water carriage in sewers; (b) that crude sewage should not, on any account, be discharged into streams or rivers, but should be purified by filtration or otherwise prior to discharge; (c) that where it is possible, it is desirable to make arrangements to discharge the sewage of inland cities and towns upon sewage farms.”

Further, with reference to the question as to “whether the cost of an effective dry carriage system of both fluid and solid sewage can be brought within the means of Indian towns and cantonments,” they add :—

“The Committee were unable to form an opinion on the subject, as they had no information and were not in possession of facts regarding the financial position and responsibilities of Indian towns and cantonments. The circumstances and physical conditions affecting the different communities of the various parts of India necessitate a special study of individual townships in elucidating the cost of the separate or combined removal on approved principles of solid and liquid sewage.”

It will be seen that the Committee very wisely declined to lay down any general principles for all India regarding a dry carriage system of sewage; but I venture to quote from a joint report of Mr. Hughes, the Sanitary Engineer, and Surgeon - Major Hutcheson, the Sanitary Commissioner, regarding the drainage of Cawnpur, written in November, 1892, which will show why they consider the trenching system, which has been hitherto resorted to in all these five cities, as well as in all other municipalities in the North-West Provinces and Oudh, to be, in the case of such a town, incomplete and objectionable. They write :—

"On the west of the Ganges Canal the arrangements are of great interest, because they illustrate strongly the defects of the system of surface drains for sullage water combined with the removal of the excreta by hand and cart.

"This system was introduced by the collector of Cawnpur, in 1872, and the Municipal Board has, in our opinion, made a very honest attempt to carry it out, and, considering the untrained agency at its disposal, with as fair an amount of success as can be expected from such works, with such materials used. The two natural drainage lines of the town have been joined with masonry, and partly covered and converted into main sewers, and a system of surface drains connecting with these main sewers has been gradually carried out from year to year. The Municipal Board has, during a term of years, in this way spent Rs. 2,13,000, borrowed from the local government, on its main sewers; and the surface side drains have been gradually carried out and paid for from current revenues.

"These surface drains vary in section, from shallow saucer drains to deep rectangular pockets running along the face of the houses, and sometimes under the platforms on which the food-supplies are exposed for sale. The material is brick of inferior quality, and the mistakes with regard to fall and gradient are numerous, leading in many streets to the ponding-up of the sewage until it soaks or evaporates during the day. The pocket drains are constantly used as receptacles for sweepings and rubbish, which choke them and intercept their flow; but, notwithstanding these disadvantages, there is a very real attempt made by the householders to keep them clean; for although there is no water-supply except that drawn from wells, there is a flow along the surface drains at certain hours of the day, often sufficient to work an ordinary pipe-sewer.

"We find that the contents of pails, taken from privies and latrines and carted to municipal trenching grounds, amount to 912,500 cubic feet per annum—about $5\frac{1}{2}$ cubic feet per head per annum—about 1 lb. per head per day.

"We estimate that the lowest computation—the quantity of sewage to be dealt with under a perfect system of hand-removal, would be—

Excreta	3 lb.
Two lotahs of bath-room water from privies	4 "
Cook-room sullage water	5 "

—

Total per head per diem 12

"Probably not more than ten per cent. of the total sewage is, in fact, dealt with by hand-removal, and the remainder either soaks into the ground, where surface drains are imperfectly carried out, or finds its way into the main sewers through leaky and absorbent side drains. The character of this sewage, when collected in the main sewer, is remarkably offensive: it is pure sewage of a very concentrated description.

"Turning from the proposed system of under-

ground sewers for the water-carriage of sewage, we regret to find that the Government of India advocates such a measure as the introduction of a system of hand-removal of sewage by pails and tramways. Every available plot of land in the immediate neighbourhood of Cawnpur has been deeply and foully trenched for centuries, and it is, we learn, impossible to find land within a measurable distance for the purpose of the disposal of such sewage. The difficulties of such a system are enormous, chiefly in the discipline of the great army of carts and sweepers employed on this degrading work; probably not less than 4,000 to 5,000 sweepers are at present employed in Cawnpur on it, with the result that 912,500 cubic feet per annum is carted to trenching grounds, and we estimate that not less than ten times this quantity is carried away to the sewers in street gutters, or soaks into the ground. The cost of carting 912,500 cubic feet is now Rs. 26,500 per annum; a complete system of hand-removal, which would effectively deal with the total volume of the sewage in the Cawnpur municipality, would cost at least ten times this amount. The cost of the present, very imperfect, sewage removal is now something like 3 annas per head per annum. The cost of conservancy with very short leads was, in the 9th Field Battery R.A., Rs. 8 per head per annum, and in the Lancashire Regiment Rs. 2. No great and crowded city can be effectually purified by handling sewage; in jails, barracks, and regimental bazaars it is sometimes possible, under the pressure of strong discipline, to obtain results which, for a time, conceal its defects; but as a measure applicable to the sanitation of great cities, it has long since been abandoned by practical sanitarians, because the cost is excessive, and the result on the public health disastrous.

"The true key to sanitary progress in cities (they quote here from the *Progress Reports* in the Indian Sanitary Report (1870), p. 45) is water-supply and sewerage. No city can be sufficiently purified by mere hand-labour in fetching and carrying."

"Cleanliness cannot be secured by dealing only with the pail contents of privies and latrines. To make the purification of a city complete, the removal of these fluids must be so thorough that drains may be safely dispensed with, and the most moderate calculation as to the minimum quantity of fluid sewage to be dealt with on this plan shows that the cost is prohibitive, even if it was physically and administratively possible to collect and handle such a bulk of sewage with any hope of success. On the other hand, if the present cost of carting is capitalised, it will go far to furnish a tolerably complete system of pipe sewers. If drains of any kind are wanted for any part of the sewage, it is necessary and economical to have underground drains and a complete system of sewerage."

I have given these extracts at some length, because they embody the arguments of experts

against the system of trenching now in vogue in Upper India, which has strong support, and the prescription of time in its favour, but which is open to equally strong objection. At present it stands in the front of opposition to drainage projects.

It will be asked, possibly, whether these large and costly measures have been thrust by the Provincial Government on the municipalities concerned, or whether they have, of their own initiative, adopted them. The moving spirit has been the chairman, who is the district magistrate, and the provincial government has strongly backed him; but in most of the cities the board has, without serious hesitation, followed the district magistrate's lead. In Cawnpur and Allahabad there is a considerable European and Eurasian element in the board, which has given the support that might have been expected of it. Of the native members, a few have been ardent and consistent advocates of a water-supply; others have accepted the views urged on them, from complaisance, indifference, or from a feeling that their colleagues were likely to be better informed than they held themselves to be. A minority has strenuously opposed the introduction of the water, on the ground of the taxation which it must cause, which, no doubt, must make itself felt. Most members of the municipalities concerned have given their adhesion, guided rather, I should say, by faith than by insight. But there have been many notable exceptions among the native members; and without the zealous co-operation of these it would have been doubtful if the boards as a whole would have been prepared to adopt such extensive and expensive measures.

An Act to provide for the disposal of administrative points connected with the putting into effect of water-works became law in 1891, and a Drainage Act has recently been passed by the Legislative Council. In 1892 there was also passed a Lodging-house Act, to guard against overcrowding, and to allow of the control of pilgrim lodging-houses and the charges incident thereto.

So much for Urban Sanitation. Though the work in these five great cities has been accomplished, the other large centres remain in the condition of water-supply in which the Hindu handed them to the Mogul, the Mogul to the Queen. The most populous and important cities have, happily, been the cities most easily and at least cost supplied with water, because situated on great rivers. In some of the other towns the problem will be more difficult,

because their resources are less and their distance from water-supply greater.

The last branch of the subject to be noticed is that of Rural Sanitation. Something has been already said of the distribution and sanitary condition of the rural community. The needs and advantages of rural sanitation, it must be here added, are entirely foreign to the native mind; and any measure adopted to ensure them will be regarded by the masses without irritation, so long only as sensible interference with their present habits, or so long as widespread pecuniary assessment are abstained from. In proportion as one or other of these press upon them, will be deep discontent and annoyance. It is of the first importance that irritation and annoyance arising from the measures of the Government should, as far as the rural classes are concerned, be avoided in every possible way; and it is better that the rural population should live in an unsanitary condition than in a condition of acute irritation and discontent, arising from efforts (especially if, at the best, such efforts must be very partial of success) to improve rural sanitation. Any attempt to coerce these close-gathered many millions into sanitary observances is in the highest degree surrounded by difficulties, owing to the enormous area and population concerned: the countless small centres in which it is congregated: the comparatively small agency which could alone, from financial necessities, be employed in watching or promoting sanitary measures: and the absolute certainty, from the impossibility of effective superintendence, that the staff of such agency would habitually abuse the authority given to it, and exercise it for its own pecuniary profit.

Widespread discontent among the rural 41,000,000 is a very different matter to any impatience at the increased burden of taxation, for example, which may be felt among the limited million or so of the great cities. The propriety or expediency of endeavouring to lay the foundations of measures having for their end the gradual improvement of the health of the rural population and the sanitary conditions in which they live is unquestionable; but the adoption of provisions embracing the whole or any considerable majority of the rural population, or partaking of a coercive character in any feasible degree: still more, the adoption of stringent or vexatious measures in this regard, cannot be too carefully avoided. Sir William Moore's views in this regard, referred to at the

commencement of this paper, are especially applicable to the rural population.

It has, therefore, been the aim of sanitary reform in the Provinces under review, as embodied in the North-West and Oudh Village Sanitation Act of 1892, to limit its operation, for the present, to villages having not less than 2,000 inhabitants; and to these, again, in districts to which the Act may from time to time be extended by the provincial government. The population of sites numbering over 2,000 inhabitants amounts, deduction made of municipalities, to 6,000,000 approximately, and there are about 1,900 such villages. It is desired to confine the scope of the action to be taken at present mainly to the survey, provision, and maintenance of a better water supply in the limited class of villages, containing more than two thousand inhabitants; and to providing for the protection of wells, or such other elementary measures as may be carried out effectively, and without serious annoyance to the people. The first point aimed at has been to secure, by degrees, a fairly good water supply for these villages, and to that end, power has been taken to cause all their wells used for drinking purposes to be analysed, and to institute, under the control of an organised staff, a village-to-village survey of wells. The law empowers the district magistrate to carry out the measures necessary to preserve from contamination all wells in such villages which are used solely for drinking purposes; to close all such wells of which the water is condemned as irretrievably bad; to take measures, by his direct agency, the cost being in such case recoverable from landlord and residents, or by loans to the village, for the construction of wells for drinking purposes, and for the improvement and repair of all such wells whenever they may be required. The Government is empowered to make rules regulating conservancy in these villages, and providing for the protection and periodical examination of the water supply, and defining and prohibiting public nuisances. Power has also been given, in the case of prevalence of a serious epidemic or infectious disease, to cause village sites to be cleansed; to dispose of corpses by cremation or by burial; to prohibit the use of contaminated wells, or to close them; and to destroy or dispose of materials likely to cause infection.

The Sanitary Engineer, who was in 1888 seconded and detached for municipal sanitation, was, in 1892, brought back on to the direct staff of the Government. He has been made a member of and secretary to the Sanitary

Board. A small subordinate staff has been, or is to be, allotted to him in each district into which the Act is introduced; with his aid and advice, and that of the Sanitary Board (of which the Sanitary Commissioner, it will be remembered, is a prominent member), the district magistrate will control the immediate operations under the Act.

To the sanitary reformer all this may seem infinitely little; to the administrative officer it may seem a great deal too much; to those who decided on it, it seemed to provide a sound base from which in course of time if experience proved encouraging, further advances might be made, whether as to the limit of population in villages to be brought under the sanitary besom, or as to the measures to be taken in regard to such villages. As yet, it is believed, the rules to be published under the Act, giving full effect to its conservancy sections, have not been issued. But Hindostán, which has awaited sanitary guidance from the dim morning in that forgotten century when the first Aryan host encamped itself on the banks of the Jumna, to the hour when, at its final confluence with the Ganges, there was passed Act II. of 1892, may watch with composure the lapse of a few more months before the complete machinery of that Act is set in motion.

This review of the sanitary measures adopted in one of the many Provinces of India, in pursuance of instructions promulgated by the Government of Lord Dufferin, is now, so far as the limits of this paper and my ability permit of it, complete. Like the subject of which it treats, it leaves much to be desired. But it has endeavoured to show that in our cities certainly, and in our villages, it may be hoped, a real beginning has been made. The Ganges and the Jumna, to whom, for countless centuries of suffering, pious hearts have hourly offered fruitless prayer, are at length under the guidance of British rule coerced into compliance with their worshippers. Their living waters which, under that guidance, have for many years past poured wealth throughout their stately course into the bosom of the innumerable agriculturists, now flow through the streets and pass into the houses of the most crowded cities on their banks. Let us trust that the beginning so made will be followed up with system and with energy. Sanitation is but one of the many claimants on Indian funds; it is, as I have said in the first words of this paper, the Cinderella of Indian administration. Money is needed for sanitation, and constant pressure

on those who have the disposal of money. There is so much to be done in the various provinces of India—so many railways to be constructed to-day, so many armaments to be hurried on to-morrow, such searchings of heart at all times for currency's sake, so little local effort, so much for the overtasked Government to accomplish, such few centres of enterprise, so many fields for activity, that poor human life among it all is the last to be thought of, and the first to creep into its grave. In sanitation there is little that is generally attractive. There is neither pride, pomp, nor circumstance. In the prevention of disease there are no rolls of honour. The work of sanitary reform is nameless and noiseless; not vaunting itself; and, therefore, like the charity of which it is the offspring, greatly considered it may be, but not always greatly practised of men. If it is to be largely extended in India, ceaseless watchfulness, active encouragement, and discriminating philanthropy are needed. Philanthropy, seems sometimes, like justice, to have a bandage on her eyes. Foul water is more deadly than ardent spirit, slaying its tens of thousands to the units who in Upper India succumb to inebriety. Bad drains or no drains are far more fatal than the poppy-head; and the neglect of the one is a greater reproach to the Indian Government, and an infinitely greater danger to its subjects, than the cultivation of the other. It is in the hope that renewed attention may be called in the counsels of this Society to the more obvious but more generally neglected aspects of health requirements in the several provinces concerned, that this paper has been written. Imperfect and uninteresting as it may be, it will have served its purpose if it stimulates others, more competent, to keep public attention fixed on the unsanitary conditions and on the sanitary claims of a section of her Majesty's Indian subjects.

DISCUSSION.

The SECRETARY of the Section read the following letter from Miss Nightingale, to whom he had sent a copy of the paper:—

“April 25th, 1894.

“DEAR SIR,—I am extremely obliged to you for sending me tickets for Sir A. Colvin's paper to-morrow. It is on a subject which has deeply interested me for years and years. I wish I could come to hear it myself, but you have done me a great favour in sending me a copy of it.—Yours faithfully,

“FLORENCE NIGHTINGALE.”

Sir HENRY CUNNINGHAM, K.C.I.E., said that, speaking for himself, and many of Sir Auckland Colvin's friends whom he saw around him, he was quite sure they all felt the greatest satisfaction and pleasure in welcoming him back to England, fresh from his labours in the East, and able to give an account which, to every person who knew anything of administration, must be in a high degree satisfactory, of improvements and reforms which had of late years been effected in India. To old Indians it was a positive refreshment, after all the nonsense which was talked out of doors about Indian reform—projects which they knew to be impossible, and even mischievous, proposed by ignorant people to people as ignorant as themselves—it was a relief to turn from them to an account such as that to which they had just listened, given by a man who knew the subject down to the ground, who had worked out its every detail, thought out its every possibility, and who presented a scheme of practical, sensible, moderate, well-adjusted improvement, as good as it was possible for human ingenuity, with its necessary limitations, to suggest. It was one of the honourable functions of that Society to call public attention in this country to sober and rational projects, and thus to educate public opinion. English opinion was powerful in Indian matters, but not always wise. There was one instance connected with sanitation to which he could not further allude than to say that it was a policy by which hundreds and thousands of soldiers every year were incapacitated, a policy due, in a great degree, to misguided views and English prejudice. Every one acquainted with the administration of India, from Lord Roberts, who was one of the most ardent promoters of reform, down to the lowest official, would be prepared to admit that this policy, forced on the Government by public opinion, was entailing a dreadful calamity on the army of India. That being the state of things, it was in the highest degree consolatory to find, from a gentleman who knew the particulars of Indian sanitation, that, despite all obstacles, a useful and beneficial work was being effected, which must command the respect and gratitude of all thoughtful men. The more one examined the administration of India, the more reason one found to be satisfied with the results achieved, and to rejoice that our countrymen in the East should be showing such assiduity and capacity, and should be so efficiently carrying out reforms largely conducive to the happiness and welfare of a vast community.

Sir JOSEPH FAYRER, K.C.S.I., wished to say how much he admired and how much he had profited by the paper now read by the distinguished administrator, who had given an account of the sanitary conditions, and of the means which had been taken to improve them, of the great province, with a population of over 40,000,000, with which he had recently to deal. He was specially delighted with the paper because it was not burdened by theories. It was plain, practical, common sense. It told you what everyone knew who

had any large experience in dealing with disease and the insanitary conditions which diminished the health, increased the death-rate, and intensified the misery of the populations concerned. There were no theories here of etiology, but ample suggestions and instructions, and a good deal in reference to dealing practically with the prevention and removal of disease. He was glad to hear Sir Auckland Colvin call attention to the necessity of considering each province of India by itself. People were too apt to forget the size of that enormous country. They forgot that it was as large as the whole of Europe, excluding Russia; that extending from the torrid zone up to the regions of eternal snow, it presented every variety of climate, every degree of humidity, and all other conditions out of which a climate is made, and which minister to the genesis and spread of disease. All the suggestions made had no doubt partly been carried out; at least, many of them. The scheme seemed costly, but he was also glad to hear that Sir Auckland Colvin recognised the necessity of *festina lente*. You could not force these people, people whose ancestors, at all events, were civilised when ours were painted savages. They were very hard to move. But, still, an impression had been made upon them, and he believed now even if—which God forbid—we should leave the country, still we should leave some vestiges of what we had taught them as to preserving their health. The necessity of pure water, pure air, the absence of overcrowding, and all those conditions by which disease was intensified, were all insisted upon. The one connected with water was the most important, not only because it might contain bacilli, or germs of certain diseases, but because everybody who had studied the subject must know that impure water in any form might give rise to or intensify a variety of diseases. It had always been found a difficulty where the natives and others were accustomed to drink out of wells, that the water (itself originally not over pure, containing a quantity of saline matter derived from the percolation of the rainfall through the soil, and which varied from 10 or 20 to 300 grains per gallon in the wells) received all the impurities of the surface. Tens of thousands of microbes might thus find access, some possibly very prejudicial, and that had been one of the many sources of pollution of drinking water. He rather gathered that it was implied that the natives were not very particular about the water that he drank; but that was not his experience. They were very ignorant about what was pure and what was impure, but they seemed to have a power of recognising what was good water; and his own opinion would be that if there were any one thing in the world a native attached importance to it was the purity of the water which he drank. You might wander about in that great pestilential tract of land called the Terai, which was a submontane belt of jungle at the foot of the Himalayas, rendered damp and pestilential by the water of the hill-sides, which percolated down until, meeting the clay, it welled up and caused almost a marsh. That

was one of the most pestilential districts in the whole of India, extending from the base of the Himalayas along the Ganges into Assam. People might there contract the most dreadful forms of fever, and no doubt the mortality caused was very great. But there were other districts which were very liable to fever also; not merely febrile diseases, such as inflammation of the chest and lungs, but endemic fevers, and they killed more than all the other diseases put together in India. If 6,000,000 of people die yearly out of the 287,000,000, there could be little doubt that 3,000,000 of those perished of fever. They were nearly all caused by what, for want of a better term, was called malaria. We were not now quite so ignorant about this malaria as formerly, but that was not the place to enter into pathological descriptions. Still it would be unjust to the younger race of medical officers in India not to recognise that they had contributed very much indeed, as well as the French and other observers, to much knowledge of the true nature of those diseases. This fever was not by any means irregular in its incidence, though fluctuating, to a certain extent. The last year reported upon officially was an unhealthy year, but still the death-rate from fever was a tolerably equal figure. It was not so with other diseases; bowel complaints, cholera, and others were most varying, dependent on epidemic activity and seasonal changes. All these were, to a great extent, diseases under the control of sanitary work; not theoretical work, but practical teaching in common sense and cleanliness, and that people should have enough air to breathe, enough food and pure water, proper clothing to cover them, and an education such as to minister generally to their well-being. In this there was a promise of improvement, and it was mainly due to the encouragement given to it by rulers such as the one who had now spoken; for these great authorities sympathised with the difficulties the sanitary officers had in giving effect to what they knew to be necessary. Such a paper as this must be of great service, and he hoped it would be published far and wide; that the authorities of all India would read it as they did the previous paper by Sir Henry Cunningham; and that in time to come the death-rate would be lowered, and the value of human life would be enhanced, as well as the social, moral, and material welfare of the people. If it were so, it would be due in great measure to the influence exercised there by our own countrymen, such as the gentleman who had now spoken.

Sir DOUGLAS GALTON, K.C.B., F.R.S., said he had never been in India, and his only acquaintance with Indian sanitation was derived from the very valuable reports he had read from the various Sanitary Commissioners of the Government of India which had been sent to the Army Sanitary Committee. He should like to say, however, how very interesting this paper had been, and how much they were indebted to Sir Auckland Colvin for having brought to a focus the interest-

ing work done in recent years in India. If they looked back at what the condition of sanitation, even in Eng'and, was some 40 or 50 years ago, it would be found that many Indian villages were quite as forward as many English villages were at that time; and if we had progressed here in the way we had, by sanitation, penetrating from the upper classes downwards, one might hope that, in the course of years—many years, no doubt, but still years which might be reckoned—the Indian populations would gradually receive ideas on sanitation in the same manner from their own upper classes. The amount of progress which seemed to have been made in the larger towns, and had now been carried into the villages, was one of the most hopeful signs for Indian sanitation.

Surgeon-General I. M. CUNINGHAM, C.S.I., in common with the other gentlemen who had spoken, had listened to this paper with great pleasure, all the more so because it inculcated the principles which for many years he had striven to inculcate himself; and it was always a pleasure to find, after many years' experience, one's recommendations had received the impress of approval by time. He fully agreed with all Sir Auckland Colvin had said as to the great importance of the sanitary improvements required in the towns and villages of India. It was impossible to exaggerate the unfortunate state of many of them at present. The difficulty of dealing with these things was also very great. It was not so great in the towns as in villages, but he was still hopeful that with the spread of education even villagers might in time come to learn the benefit of sanitary improvement by means of education in the schools, better registration of births and deaths, and by seeing the practical results which flowed from the improvements in certain towns as they went on. No doubt much might be done even in the villages in the way of simple sanitary work, such as taking water from pure sources and preventing its defilement, and also by, at all events, advising them to avoid the use of impure water, which latter was unfit for their use. He was extremely glad to find Sir Auckland Colvin had given expression to very much the same opinions as he had himself. It must be remembered that everything done in India ought to be done with the greatest regard to the feelings and prejudices of the people themselves. Looking back on his Indian career, he could truly say that if he was ever able to do anything for the benefit of the people it was by restraining people with theories from pushing them to an extent which would be most injurious. He had known many instances of people animated by the most lofty and generous feelings, so anxious to carry out the theories of the West in India, that they would inevitably have succeeded in producing very great discomfort and social misery amongst the people. We were too apt to forget that sanitary science was comparatively new. A few years ago the villages and towns of England were not very much better than those of India, and there

were still countries in which the villages were in a state, some of them at any rate, which was not one whit better than many Indian villages. He was glad to see also that in the matter of water-supply great stress was laid on the importance of having a system of drainage coincident with it. He observed in the last Bombay sanitary report that complaint was made that the introduction of the water, which was used liberally, had had the effect in some places of saturating the subsoil, and so, it was believed, causing fever. It was essential, therefore, that any scheme of water-supply should be joined with a scheme of proper drainage.

Sir ROBERT RAWLINSON, K.C.B., said he had the pleasure and hard work of serving with his friend Sir Douglas Galton for twenty-two years on the Army Sanitary Committee, and of having done a great deal of work as best he could to give instruction for the improvement of India. He had read the reports which came in, and had considered the question in all shapes; but he had always felt that he had laboured under one great drawback, as he had not seen India. Therefore he concluded any efficiency he was able to bestow was only a sort of left-handed one, as he was working half blind. With regard to the water-supply of India, upon the whole it was about the most abominable that it was possible for the human mind to conceive of. In the province of Bombay the Commission had analyses of hundreds of wells that were used for human purposes, every one of them tainted more or less with human bodies, and from some of them bushels of human bones had been taken. Then, again, with regard to open tanks, the Indian natives, according to his reading, would drink anything. They washed in an open tank, they bathed in the tank, voided excreta in the tank, and some of them drank of it. With regard to the purified or filtered water for Calcutta, he was told, or read, that the water-carrier went to the stand-pipe, filled his vessel two-thirds full with filtered water, then went to the nearest puddle he could get to, and filled it up with his hands, and when asked what he was doing he said, "Making Ganges water for master." With regard to sanitary works for towns, such as main sewerage and water supply, he shrunk from recommending that such work as is done in England should be undertaken in India on the principle and with the rules and regulations adopted and successfully carried out in England. He could not imagine that plans and sections from this country would be applied to India with any chance of success. They would incur a very large expenditure, and might utterly fail. He had once to examine a set of plans made for Sierra Leone. He could not find fault with them, because they were made from exact copies of his own details and instructions, and the estimates were based upon them, but he could not by any means recommend sanitation upon an English plan and scale

for Sierra Leone, to be supplied to a population of negroes. Before they adopted sewers and drains they must look to the surface of the roads. There must be streets properly formed and kept in order as they were in England. What could be done with main sewers and house drainage if we had no pavements and no proper regulations for scavenging? Again, the character of meteorology in India must be considered, bearing in mind that there were conditions to be complied with there of which little was known in England. For instance, the monsoons occupied about three months out of the twelve, and during that time the rainfall might be from 16 to 20 inches, in the 24 hours. What kind of sewers could be made to carry off flood water of that kind? He had laid down the principle for India that the sewerage or drainage should be adapted to the water-supply to be removed, and should be the minimum of capacity and not the maximum. You might ruin Calcutta, or Bombay, or Madras by making sewers to take even the average rain that falls during the monsoons, as if they were as big as railway tunnels, some of them would be full. The flood water now went over the surface, and it must continue to go over the surface. You had to lay this rule down even in England before you began to deal with the subsoil; examine the surface and what was upon it as far back as you could go, and then do not contemplate making your sewers equal to an average fall of rain. You must go below the average, and if any portion of the surface had been waterlogged you must make arrangements for getting that water off without getting it into the sewers*. With regard to the drainage of the metropolis, before it was commenced thirty years ago, there were great contentions about the introduction of new rules for sanitary works. The new Commission made inquiries about the rainfall that fell on London within a limited time, and began by taking one inch in 24 hours, and from that they calculated what sectional area the sewers must be. But they very soon found that would not do. Then they went to half an inch, then to quarter of an inch, and ultimately, I think, they went to one-eighth of an inch, and after four or five millions of money had been laid out on the main sewers, it was found that large as they were, when heavy falls of rain came on to portions of the area, that area was flooded, and one or two millions had been laid out since to make great sham water outfalls into

the Thames in order to pass off the surface of the ground those excessive rainfalls. If that were so in England, what must it be in India, and how careful must the engineer be in his expenditure on sewers to avoid throwing away money to defeat his object, because he could not carry the whole of flood water in sewers; he must pass it over the surface. He reported on the water-supply of Calcutta, of Bombay, and of Madras, but nothing came of his work. The reports went out to India, but certainly nothing practical came of his work. There again, it was folly to expect that you get advice from England beneficial in India from London examples. They must begin at the beginning in India and make examples for themselves, and design and carry out sanitary works so as to meet their own requirements. They must not put up for native uses water-closets for instance. The high-class Brahmin would never attempt to use a water-closet, because he would not let his skin touch anything that had been touched by any other human being. When the Sultan came to London they had to take all the water-closets out of Buckingham Palace and make holes in the floor in accord with Turkish uses; and for India generally, nothing more than that could be done, and cleaner and better it would be if it were properly carried out. With regard to the disposal of the refuse from towns, the only proper way to get rid of it was by means of fire.

Sir WILLIAM WEDDERBURN, Bart., M.P., after paying a tribute to the high character of the paper, said he quite agreed in thinking that if we were to make any progress in sanitation in India we must get the people to work with us, not put it into the hands of ill-paid subordinates, who only use their power for the purpose of oppression. While agreeing with Sir Auckland Colvin in much of what he said, he should wish to put in a demurrer as to his alleged fallacy with regard to the treatment of India. The reader of the paper laid great stress on the differences that existed in different parts of India, but he would say rather that the differences existed, but they were in great measure superficial. That under the surface the great body of the people were Indian ryots living in Indian villages, and their condition of life was very similar in all parts of India. The dominant classes were different, but he found the same village life in every part of India in which he had ever been. The village was the unit, and in those villages 90 per cent. of the population lived. They had to deal with these villages, and it seemed to him the problem was to a certain extent easy in this respect that you had to deal with that small unit. If you could make one village sanitary and healthy and prosperous, you had found a clue to making all the hundreds and thousands of villages throughout India sanitary and prosperous also. Therefore he thought the Bombay Government had proceeded wisely in their village sanitation Act, in which they had taken the village as the unit, and set themselves to re-organise that

* India can only be dealt with in a beneficent and economical manner by educated natives, and true sanitary improvement must be taken by the educated and wealthy natives. The works must be simple and cheap. Indian villages cannot be sewered and drained, as such works, with a scant supply of water, would strike. Soil-pans would only be abused. Surface draining, scavenging, and refuse-burning will have to be relied upon. The apparatus for water-supply must be cheap. Wrought-iron, screw-jointed tubes, inch diameter, with house branches half-inch, and screw-down taps, three-eighths, will be sufficient for a village population of 1,000 persons.

village, to bring the people to work with them, and to teach them as far as possible those simple methods of sanitation to which Dr. Cunningham and others referred. The only objection, the strong objection made with regard to the administration of that Act was simply this—that money was not forthcoming. Under the old Local Government Acts cesses were raised in the villages, and those cesses went to the central authority, and were mainly used for general purposes of communication and so on, and then small grants were afterwards given back to the village for sanitation and other purposes. What they said was that the necessary minimum of sanitation should be the first charge on the cess raised in each village, and until that village was made fit for human beings to live in, no money ought to be taken away to be applied by the central authorities for any purpose whatever. This village sanitation Act was a good one, but it was practically a dead letter at present for want of funds, and they said funds should be obtained in that way. He would only make one other observation, and that was with reference to the proposal of the distinguished lady whose letter had been read, Miss Florence Nightingale. She took the greatest interest in sanitation, not only in England but in India, and she was very much impressed with the necessity of getting the people to understand the necessities of the case, and themselves by their own hands to carry out small useful works which really did not need much expenditure, if the people themselves were once convinced of their necessity. Her proposal was that the Government should encourage them through teachers, something like the Health Missioners, who had been established in some counties in England under the County Councils. Persons well-informed, both of the condition and habits of the people, and also of simple sanitary rules, should go round, and by object-lessons and instruction on the spot—perhaps by magic-lantern views showing the microbes found in the village well, and so on—persuade the people and work on their religious feelings, because purity was the keystone of their religion, and working upon those feelings, they might get local opinion with them, and then get them to come forward and assist the Government in their good intentions. In this matter they should not trust to local effort only, nor only to central impetus. Both were

Mr. LEONARD said it was a great satisfaction to know that the country would now be informed that the Government of India were really doing such useful work in the North-Western Provinces, and after the great majority of people that had done nothing, wanted. They wanted the people to help themselves, and they also wanted the almost omnipotent Government to give them the help it could very well give.

Brigade-Surgeon R. PRINGLE said he had served as sanitary officer in the districts alluded to in the paper, and he felt that the beginning

of a great work in India had been started, because it was true in India as it was here, that the lower orders looked up to see what those above them did. What the Raja did, the ryot would follow. He must be the moving spring in everything that took place in India. If he would keep his well clean and explain it to others, they would do the same. But above all that, was the civilian, and he could mention the name of one whose work was an illustration of what every civilian could do. Mr. Harding, in Muttra, explained to the people that sanitation was the only hope of that place ever getting on, and in consequence thousands of rupees were spent there; and when speaking to some of the natives on the large sums spent, they said, "If Harding Sahib wants a few more thousand rupees he has only to ask for them." The result was that many towns in this district followed this good example. It was no use showing magic-lantern views to the natives to show what was found in the well, but tell him to put up a little parapet so that the well should not be a cesspool after every shower of rain. If they taught the upper classes, amongst other things, the danger of that system of having the well half of it in the compound and half in the street, and get them to move in it, he had no fear of the ultimate result. One name ought not to be omitted in connection with this subject, and that was the honoured name of Lord Dalhousie. Forty years ago one of the bye-laws of the railway was that free water should be given to every passenger at every railway station in India, and no one knew what benefit that had been. Some could remember what the sympathy of Mr. Colvin, with all the weight of the Mutiny on his head, had been able to do in Agra; and he was glad to think that one so closely connected with him had taken the prominent part in sanitation which the writer of the paper had done. If India were able to get rid of its fearful death-rate, it could only be done by a good water-supply and by simple sanitary measures.

Lieut.-Col. LE CHAMPION said a great deal had been said about pure water, but he did not hear any suggestions that it might be procured by sinking wells, the water to be lifted by windmills and archimedean screws, and he had obtained an estimate from an engineer which showed that they could be erected with a screw which would reach from 30 to 50 feet at an expense of 200 to 250 rupees each. There existed two windmills, one at Madras and at Roorkee, where they fully answered their purpose.

The CHAIRMAN said I have been requested in the name of the Committee of the Indian Section of the Society, to thank Sir Auckland Colvin for the paper he has read, and I am sure that I only express the feelings of everyone present in saying that a more interesting, more enlightening, and more thoroughly satisfactory address the Society had not heard this year. It is not everyone who could make an address

on the subject of sewerage a real literary joy. It is not only the literary touch but the lucid arrangement of facts and the moderate, sensible tone, and the wise suggestions with which the address is filled, which make me say that the Society is deeply thankful to him for the pleasure he has given us all. Sir Auckland Colvin has told us of the recent developments, especially in cities; and it will be noticed that he confines them mostly to drinking water and drainage. He has told us of administrative machinery and of funds, and of work carried out by the help thereof. I cannot follow him in regard to the vexed questions of sewage removal; they are secondary, important only in great cities, and great cities in India are mostly on great rivers, and I, for one, am content, for the present, with river removal in great cities. I wish to confine my remarks to two main points, first, the justification for devoting most of our efforts to large cities, and mainly to pure water and to drainage; secondly, the condition of things in Bengal. In regard to towns and municipalities, Sir Auckland rightly pointed out that without the move made by Lord Dufferin's government in sanctioning advances from Government to municipalities nothing like the progress described would have been made. That is the keystone of the policy. The sanitary commissions are useful consultative bodies, but from their constitution they cannot have any initiative, still less executive capacity. Municipalities are corporate bodies, who have funds and taxing powers, and can maintain establishments, besides being able, so far as their lights go, to appreciate pure drinking water and the larger sanitary principles. They therefore were in a position to take advantage of the new principle introduced by Lord Dufferin's government, and have done so freely. But none of these necessary preliminaries are possessed by rural populations, at least in Northern India. They have not the means, either in money or establishment, to work out their sanitary salvation, nor have they the rudimentary knowledge which would prompt the desire to use these means if they had them. A previous speaker has referred to the scheme put forward in 1892 by Miss Nightingale, a name which can never be mentioned without reverence and gratitude in an assemblage of Englishmen, with which scheme the speaker and others associated themselves. They memorialised Lord Cross, calling attention to the terrible deficiencies of rural sanitation in India, and asking that village cesses (alluding specifically to Bombay) should primarily be spent on village sanitation by local organisations, and only the surplus funds devoted to the present objects, of roads, public works, dispensaries, &c., and this was justified on the ground that life is the first necessity, and the conveniences of life come afterwards. The memorial was forwarded to all the local governments, and I doubt not will have received the respectful attention which the reality of its complaints, and the authority of the signatories, certainly demand, but without anticipating the action which may be taken, it may be pointed out

that existing local cesses are by law devoted to other objects, and that to undertake village sanitation does and must mean fresh taxation; that the village community is not educated up to an appreciation of it, while they do appreciate roads, education, and medical relief; that if we are to make sanitation hated the best way is to connect it with fresh taxation; that there is a real danger in interfering with the immemorial domestic habits of millions of a conservative population. Moreover, the means of giving effect to it are wanting. There are no local organisations, no establishments (I am speaking of Upper India), and to provide these inevitably means oppression, extortion, and speculation. But something, nay much, can be done in the way of water-supply, by skilled advice, by supervising and controlling works, and advancing money for new works, and much can be done, not by, but for the villages, in regard to the drainage of waterlogged areas. In regard to the former, legislation can assist by enforcing the obligations of owners and occupiers, and it can assist the latter on the lines of the Bill now before the Legislative Council of Bengal. About the inexpediency of forcing on the rural population advanced notions of village conservancy and sanitation, opinion in India is, I believe, unanimous. Sir Auckland Colvin has rendered a real service to the State in pointing out so clearly what the danger is, and in showing what a small proportion of the population live in towns in Hindustan. In Bengal it is worse. Here the total urban population is 3,500,000, while the village population is nearly 68,000,000. In old days, the Government of India was, as you know, advised by a body called the Army Sanitary Commission, whose distinguished chief has given us the pleasure of hearing his views this evening. That body used, in stern and vigorous language, like the prophets of old, to point out, year by year, the deplorable condition of existence in India, and to offer counsels of perfection, which were, in existing circumstances, wholly impracticable. One among many impossible suggestions was, that the old village sites should everywhere be given up, and the population removed to clean and unpolluted sites. Fancy attempting such a movement with 200,000,000 of the most home-loving and conservative population of the world. "Propter vitam, vivendi perdere causas." Mohamed Toghluq tried it with the population of ancient Delhi, but not with such success as to provoke imitation. It is such recommendations as these that make Indian administrators despair of sanitation, and incline to give up the whole problem in disgust. Now, in regard to Bengal, I have been looking through last year's Bengal Administration Report, and it is significant that there, too, the work seems confined principally to water-supply and drainage schemes. The number of these proposed by Municipalities and District Boards continues to increase, and legislation has been initiated to facilitate the work in both directions. During the past year 2½ lakhs were

spent in water-supply schemes, namely, in Burdwan, Hourah, Hooghly, and on the Dacca division, where the Raja of Mymensing had already devoted a lakh of rupees. A big scheme was also sanctioned for Arrah, to which the municipality and District Board each contribute a lakh, and a wealthy zemindar, Rajah Rajessuri Persád Sing, of Surajpoora, a lakh and a half, and Taiperhash Lal Dewan, a quarter of a lakh. The fact of the greater readiness of municipalities to embark on these schemes is remarked on, and there are several in process of being floated. The most notable is Patna, which, after many years of inquiry and hesitation, has started a scheme for drainage costing Rs. 320,000; and Pari, which is the worst and most hopeless of all unsanitary towns in Bengal, even has one for 25,000. In Bengal, the Sanitary Drainage Bill before Council provides for drainage commissions to be nominated by Government for waterlogged areas. These will survey and propose schemes, which may either be vetoed or passed by District Boards. The latter Government will execute or cause to be executed; costs to be apportioned to several estates benefited; funds to be advanced by Treasury, at 5 per cent. interest, including sinking fund, as between landlord and subordinate tenure holders, to be repaid in thirty years; quota to be paid in same proportions as road cess.

Sir AUCKLAND COLVIN, in responding, said that it must be always remembered that one of the great drawbacks which attended sanitation in India was that the administrative difficulties of the Government in finding the necessary funds would make its progress slow; but the constant attention of a Society such as the Society of Arts, bringing indirect but not unwelcome pressure to bear on the Government, would, he was convinced, from time to time, be of the greatest possible use. In that belief he had contributed the paper, and in that belief he trusted that the series, of which Sir Henry Cunningham's was the beginning, and this was the third, would from time to time be continued.

Dr. VOELCKER (Royal Agricultural Society of England) writes:—I happened to be in India at the time that the plans for several of the schemes detailed in the present paper were being considered, and I had the opportunity given me of discussing them with Sir Auckland Colvin and with Mr. Hughes, the Municipal Engineer of the North-West Provinces; so I can testify, from personal knowledge, to the deep interest which Sir Auckland took in the all-important question of the proper sanitation of the municipal towns under his control, and to the energy with which the schemes were pushed forward, as well as to the care displayed in giving a full consideration to the various interests concerned. The work Sir Auckland, aided by his able officer, Mr. Hughes, carried out, is one the value of which can hardly be over-estimated, and anything I may say

by way of criticism must be taken purely as a criticism of details, and not of principles. With all that Sir Auckland has said as to the state of wells in towns I am thoroughly in agreement, and the wonder, indeed, is that more epidemics have not broken out as the result of using water from highly-polluted sources. The obtaining of a pure supply of drinking-water in towns is a necessity and a duty, and in effecting this the closing of bad wells is imperative. The state of the rivers is also, as Sir Auckland has said, very far from satisfactory, and I think that before a river is utilised as the supply of drinking-water to a town, more attention should be paid to making its condition better than it is. The purification of river water by passing it through filter beds is well enough in its way, but it is not by any means perfect, and it would be much better to see that the water of rivers is in a purer state before it is drawn in for use. I have myself seen intakes for waterworks which have been situated immediately below bathing and cremation *gháts*. There can be no question as to the desirability of supplying towns in India with filtered water for drinking purposes. I am not aware whether arrangements have been made for conveying the water into the houses, but it seemed to me that, as a first measure, it would be quite enough to provide standpipes at convenient distances along the streets, and to let the people draw the water off as required. The disposal of the sewage and refuse of towns is, however, a much more difficult matter to deal with, and my cause of complaint is that the schemes devised for the sanitation of towns too frequently conflict with the agricultural interests of the country. In India, especially, has this fact significance; for, as I have shown elsewhere, we are dealing with a country which is dependent mainly on its agriculture, and this agriculture is in turn mainly dependent on the manure supply. Hence, I cannot help looking with apprehension on any scheme which diverts from the land that which will contribute to the keeping up and increase of the capabilities of the soil. No one can travel over India without being struck with the splendid cultivation that has resulted from the use of nightsoil as manure, when water has at the same time been available. Amritsar, Hoshiarpur, Farukhabad, Meerut, Saharanpur, Cawnpore, Nagpur, and Poona furnish instances of this. A study of the whole question has led me to the conclusion that the dry system of the disposing of sewage is the one best adapted to the circumstances of India, and to the habits of the people, as well as being that most conducive to the agricultural prosperity of the country. Everyone will agree that what is taken off the land should, as far as possible, be returned to it. While water acts merely as a carrier, earth acts as an absorbent, and there is no better practical disinfectant than earth. I have visited, over and over again, land where nightsoil has been trenched, and I have no hesitation in saying that, when once on the land, all nuisance ceases; and the avidity with which land thus treated is taken up for cultivation,

and the splendid cultivation that results therefrom, testify to the great benefits derived from this method of sewage disposal. The faults of the system, as carried out in towns, are those which might be easily remedied, and have been remedied, for example, in Amritsar. I am convinced that, in many of the large towns of India the dry system has not had a proper trial. In Allahabad and Cawnpore, for instance, I never saw any absorbent materials like earth, nor any disinfectants used, nor were the vehicles used in transport properly cleansed. It is to causes such as these, and not to the dry system as a system, that the objections raised are due. In Amritsar, on the other hand, earth is carried into the houses, and a readily-portable and unobjectionable material obtained, which meets with an immediate and eager purchase by agriculturists. When it is remembered that at the present time a great part of our own city of Manchester is cleansed—and most efficiently cleansed—by the dry system, in conjunction with tramways for taking the refuse outside the city bounds, it seems absurd to think that this could not be adopted in Indian towns. The objections to a water-carriage system in India are many. In the first place, there is frequently doubt as to the sufficiency of water for flushing purposes, and already I have seen water that was primarily intended for agricultural use, taken for the towns and the crops left to perish. Then, it is recognised by everyone that the dilution of sewage with water reduces its value to a minimum, and makes it both unremunerative and excessively expensive to deal with by any subsequent process of precipitation, or treatment on the land. It has been hinted at in this paper that the water-carried sewage might be turned direct into rivers, and though I quite agree that when there is a sufficient volume of water in the river, and the flow sufficiently long, the risk of harm arising may be but small, yet not only does this involve great waste to a country like India, which needs all the manure it can get, but we cannot in these days discuss such a suggestion as that of turning sewage direct into water-courses. It is recognised now that a river is not a fitting receptacle for raw sewage, and if one town were allowed to turn its sewage in, another would follow suit, and there be no limit to the extent to which pollution might go. The soil of the North-West Provinces generally is not, I think, one that lends itself well to broad irrigation, nor is the climate suited, and the question of sewage disposal resolves itself into one of the dry system, as against that of treatment and precipitation at sewage farms. The cost of these latter will be very heavy, and the result neither as economical nor so efficacious, I think, as a properly-carried-out dry system such as is in use at Amritsar. One other great objection to a water-carried sewerage system is that, however well devised a scheme for main sewers may be, it will never ensure what is the real necessity, viz., sanitation within the houses. Herein will lie the great difficulty. Similarly, it is

very doubtful whether a system of interior or closed sanitation will ever work properly in India. The native may be got to keep clean what is open and what he can easily get at, but he is hardly likely to look after what is covered in and out of his reach. Lastly, in regard to village sanitation, anything other than a dry system is quite inadmissible, and would be attended by great agricultural loss.

APPLIED ART SECTION.

Tuesday, May 8, 1894; Professor W. ROBERTS-AUSTEN, C.B., F.R.S., in the chair.

The paper read was "Pewter," by J. STARKIE GARDNER, F.G.S.

The paper was illustrated by a large number of valuable specimens of old pewter flagons, cups, tankards, chargers, dishes, plates, ink-stands, &c., kindly lent by the Science and Art Department, the Master of the Pewterers' Company, Mr. C. J. Eyres, Lieut.-Col. Lambert, and Mr. Charles J. Shoppee. Messrs. Brown and Englefield also exhibited some modern specimens of pewter, moulds, and an old price list.

The paper and discussion will be printed in a later number of the *Journal*.

TWENTY-FIRST ORDINARY MEETING.

Wednesday, May 9, 1894; Major-General SIR FREDERIC J. GOLDSMID, K.C.S.I., C.B., in the chair.

The following candidates were proposed for election as members of the Society:—

Fox, Stephen Newcome, 12, Cromwell-crescent, S.W.

Head, Charles Arthur, Hartham-hall, Stockton-on-Tees, and Arncliffe-hall, Northallerton.

Livesey, Frank, 709A, Old Kent-road, S.E.

The following candidates were balloted for and duly elected members of the Society:—

Abney, Captain William de Wiveslie, R.E., C.B., F.R.S.; Willeslie-house, Wetherby-place, S.W.

Dolman, Osmer S., 32, Dryden-chambers, 119, Oxford-street, W., and 5, New Compton-street, Soho, W.

Eve, Richard, Aldershot.

Fuerst, Jules, 17, Philpot-lane, E.C.

Hussey, Charles, Uphaving, Hornchurch, Essex.

Mansell, Thomas, St. Thomas's Hospital, S.E.

Parkyn, Walter A., North London Scholastic Institute, Burgoyne-road, Haringay, N.

The CHAIRMAN said it was with great regret he had to state that Colonel Wells, who was to have read the paper, was quite incapacitated from doing

so, as he was not able to leave his room, being prostrate with an attack of sciatica. The paper would, however, be read by Mr. McCalmont Hill, and he was sure that gentleman would do ample justice to the office which he had so kindly undertaken.

The paper read was—

TELEGRAPHS AND TRADE ROUTES IN PERSIA.

BY LIEUT.-COL. HENRY L. WELLS, R.E.

The interest taken in the paper on "Telegraphic Communication between England and India," which was read to this Society in February last, led to my being asked to give an account of the Indo-European telegraphs in Persia, and of the local telegraph in that country from the time that I became acquainted with their administration, viz., Jan. 1881; and secondly, to bring the history of the trade routes in Persia up to date, a subject which has attracted much attention on the part of my predecessors, as evinced by papers read thereon by three successive directors of telegraphs.*

Our Chairman to-night brought the history of the Indo-European telegraphs up to 1874 by his book, entitled "Telegraph and Travel." Mr. J. R. Preece, formerly a superintendent in the departments, now H.B.M.'s Consul at Ispahan, continued the history up to 1877, in an elaborate paper he read to the Society of Telegraph Engineers.

The Honourable George Curzon, in his admirable book on Persia, gives some pages to the subject now under consideration.

The Indo-European Telegraph Company comes from London *via* Lowestoft, Emden, Berlin, Warsaw, Odessa, Kertch, Sukumkaleh, Tiflis, enters Persia at the passage of the River Araxes, which forms the frontier between that country and Russia.

Since 1880 a great improvement has been effected in the working of their line, by carrying two of the wires on bare porcelain insulators, supported at either end of an oaken arm, which is attached to the iron standards of the Siemens pattern. This system of insulation is the very best yet devised for long distance land lines in Central Asia. The third wire is still carried as formerly on a Siemens iron hooded insulator which is attached underneath the oaken arm

above referred to, and is for the use of the Persian Government.

The Companies' lines are well constructed and admirably maintained. The Persian portion of their system traverses a very elevated plateau; for instance, at Zenjan, the whole surface of the country has an elevation varying from 5,000 to 6,000 feet above the sea. The distance from Djulfa, where the line crosses the Araxes, to Teheran is 440 miles. The line runs parallel to the main mountain chains, which protect it from the north winds. Throughout the above-mentioned distance, the altitude of the country passed over by the line does not vary more than 3,000 feet. This fact, together with that of its being protected by the mountain ranges, accounts for the singular immunity from interruptions it enjoys.

If we compare the natural features of the country traversed by the companies' lines with those of the country traversed by the Indo-European Government line, which are shown by the accompanying section (p. 533), it will be seen that the latter has to cross in going from north to south, what the former has gone between in going from east to west.

Moreover, the latter has to contend with climates varying not only from a difference of altitude, which extends from 0 to 8,750 feet above the sea, but also from a difference of latitude, that extends from 29° to 35° N. The greatest cold is met with at the Kohrud Pass, and at the water-shed which divides the rivers that flow north into the great desert, from those that flow south into the Persian Gulf. At the telegraph office of Dehbied, which is situated near this water-shed, frost occurs as late as June and as early as the end of August.

The greatest heat is experienced at Borasjun, where the thermometer rises above 100° in the shade during many months of the year, and never falls to freezing point.

Whilst blizzards and snow endanger the safety of the line at its elevated portions, swollen rivers and tornadoes threaten its existence in the south. Since I was placed in charge of the construction branch of the lines in 1881, the whole length has been bit by bit overhauled, the supports being in many instances placed closer together, and the direction of the line changed where experience showed such change advisable. The result has been a vast improvement, as shown by the wonderful immunity from interruption the line now enjoys. The system of insulation, moreover, has been improved, and all three wires are now carried on porcelain insulators, supported on

* The present paper is written with the consent of Mr. B. T. Finch, Director-in-Chief of the I.E.T.D. Major-General Sir F. Goldsmid read a paper to the Society of Arts, in 1877; Colonel Sir John Champain, R.E., one in 1883; and General Sir R. M. Smith, R.E., one to the London Chamber of Commerce in February, 1889.

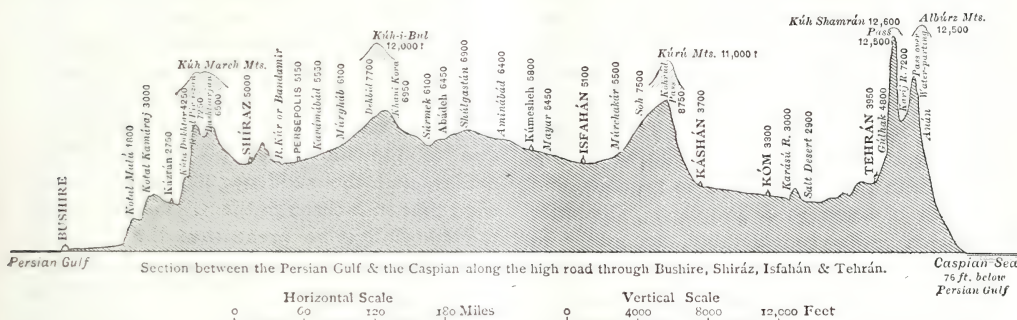
malleable iron brackets, which are bolted round the Siemens' standards. The third wire is here also for the use of the Persian Government.

At Teheran, the capital, the Indo-European Company's administration terminates, and that of the Government commences. There are about twenty-five members of the joint staff stationed here. Next to the Shah ranks His Highness the Amin-es-Sultan, the Grand Vizier. He is a most amiable and intelligent man, and one with whom it is always a pleasure to transact business. During the long lease he has held of the Shah's favour, he has always been a strong upholder of European institutions, and a firm friend to the telegraph departments. He subscribes to any amusements, such as races or concerts, that the European community may get up. Tennis and cricket are kept up by the English. In 1889, the International Telegraph-office, which had previously been in a separate build-

ing, was moved into new premises, which I had designed to house the joint International and Local Persian Administrations.

The months of June, July, August, and half September, are very hot in the city, and all who can migrate to the slopes of the Elburz range. Her Britannic Majesty's Legation moves to a village named Gulahek, $6\frac{1}{2}$ miles from the city, where a telegraphic office is kept open, and where a sanitarium is available for such of the telegraph staff as may require it.

When, in 1892, the severe cholera epidemic swept across Northern Persia, the whole of the combined telegraph staff, with the exception of one man to keep open communication with the city, were moved into tents and temporary quarters at Gulahek. The transfer of the office did not cause a moment's delay to the transmission of international traffic. The cholera reached Meshad from Herat in May, and having more than decimated the popula-



tion there, followed the road to Askabad and the Trans-Caspian Railway into Russia, which country it reached by the end of May. Owing to the dryness of the climate, and the length of the stages along the Meshad Teheran road, it took till August to reach the latter place; but then killed between 15,000 and 18,000 Persians and 24 Europeans. Thanks to the preparations made, the telegraph staff only lost one man, and was able to help nurse and bury its neighbours who were less fortunately situated. The Imperial Bank and the Mines Company lost heavily.

A marked feature in the landscape at Teheran is the lofty mountain of Demavend, which rises to an altitude of 19,400 feet above the sea. It towers above the rest of the Elburz range. The insanitary habits of the population account for cholera getting a hold in a country, where the dryness of the climate should prevent its spreading. The water-courses are generally un-

covered where they pass through villages and towns, and they are used for the washing of the dead as well as other purposes. In Persia, as elsewhere, running water is considered pure; and after it has run a certain distance as fit for drinking, whatever may have been placed in it up stream. The pilgrims flocked into Meshad when cholera was raging there, and utterly refused to turn back until they had paid their vows, and then, such as did not die in the city, carried the infection throughout the country.

The Indo-European line runs south from Teheran to Kom, skirting the great desert on its western extremity. Formerly it went through the dismal defile known as the Valley of the Angel of the Shadow of Death, a favourite resort for highwaymen, and thence crossed the arm of the desert, which is now occupied by the Salt Lake. The distance by this route from Teheran to Kom was 84 miles. The water-supply along it was shockingly bad.

In 1882, the Amin-es-Sultan decided to institute a new road which, keeping further west, should avoid the desert and insure a better water-supply. The distance would by it however be 96 miles. As soon as this commercial speculation was fairly started, it was thought advisable to transfer the line to the new road. This was done in 1883, under the orders of Colonel (now Sir) R. Murdoch Smith, the opportunity being taken to strengthen the line by placing the standards closer together. It was most fortunate that this change in its direction was made in good time for the following reason. The muleteers, who always prefer the shortest track and pay but little attention to questions of water-supply, refused to quit the old road, and thus no revenue was coming in from the caravanserais built on the new. The following plan was hit on for rendering the old road unavailable. The dam, which for centuries had diverted the waters of the Kara Chai River to a point in the desert where the sands are absorbent, was allowed to break down, and thus the river turned northwards, and flooded the clayey depression which was crossed by the old road. The consequence was the formation of a lake, which now has a width varying from 12 to 14 miles, and a length of some 30 or 40 miles. The latter dimension varies considerably, according to the season. There is now, in all probability, a depth of 40 feet of water where the telegraph line stood. The water has risen 20 feet in the wells at Kom. The formation of this lake impressed some of the Persians with the idea that the Mahdi of the Soudan was a real prophet, for a tradition existed that a sea which undoubtedly occupied the site of the present great desert, and which is said to have dried up when Mohammed was born, would reappear when the true Mahdi or 12th Iman should become manifest. The citizens of Kom are very fanatical, in virtue of their being hereditary guardians of the Shrine of Fatima, sister of the patron saint of the Persians. An unfortunate inspector, who lost a child there some years ago, had to bury it in his own cellar, as the burial of an infidel in their neighbourhood would have been resented by the Kom people. Now, however, they have become reconciled to the presence of Europeans in their midst, and the telegraph clerk is treated in a friendly manner.

In 1882, the telegraph-office at this place was swept away by a sudden flood, which came down at night. Luckily the inspector and his

wife and family were absent, or some loss of life would in all probability have occurred. The clerk in charge only succeeded in escaping after preventing a total interruption of communication by joining the wires direct.

The sudden floods, which are due to the treeless nature of the mountains, are very destructive to property. During the past winter the telegraph-office at Abadeh was washed away, together with the greater part of the town. The houses being of sun-dried brick, they offer little or no resistance to a continuous flow of water, and soon crumble away by its action, though they will stand a moderate amount of rain.

From Kom the line skirts the desert to Kashan and passes through villages which used to be liable to be pillaged by Turcomans. The altitude of Kom is 3,100 feet. From Kashan, which has an altitude of 3,200 feet, the line following the shortest route to the south rises 5,500 feet in 32 miles to the summit of the Kohrud Pass, which has an altitude of 8,750 feet. This is a difficult piece of line to keep free from interruption during winter, and it took several years to find the best direction for the wires, and overcome the difficulties due to the intricacies of the rock-bound defiles, and the sudden gusts of snow-laden wind that rush through them. On the summit the snowfall is so great that the standards have to be only 60 yards apart. There is no habitation between Kohrud, which is situated on the northern slope of the Pass, and Soh, which is situated 20 miles away at the southern outlet from the mountains. So treacherous is this pass, that people have been lost in it as late as the 21st March; and it is abandoned for general traffic during some months in winter.

I myself crossed it with the utmost difficulty in March, 1882, the illness of Colonel Smith requiring my immediate presence in Teheran. Horses and baggage had to be abandoned eight miles from Soh, and the journey continued on foot through snow often two feet deep, and in the drifts reaching a depth of six or seven feet. The guides, who were supplied with long sticks wherewith to find the track, threatened to abandon me, and eventually I had to show the way, whilst they placed their lives and that of their children and relatives on my head.

Since then funds have been provided by the Telegraph Department for the up-keep of a rest-hut eight miles from Soh, and for the clearing out of a cave near the summit of the

pass. These afford a refuge for the inspector if he has to go out on interruption duty, and are the means of saving the lives of travellers overtaken by snowstorms.

Soh is the head-quarters of the inspector, who, owing to the improvements to the line, is now able to take charge of twice as much as heretofore. The 1st and 2nd subsections having been made into one, which has a length of 247 miles. This place enjoys a magnificent climate, and from it the track slopes gently down towards Ispahan. The country is barren and treeless. The post-boy, who has to traverse this waste at all times and in all weathers, has told me he had often owed his life to the telegraph line. The line traversing as it does elevated plateaus destitute of trees, and even of well-defined natural features, and where the track is easily lost at night, and where three inches of snow utterly obliterate it, is a veritable life-saving apparatus to the happy-go-lucky Persian travellers. The ordinary Persian muleteer and pilgrim is utterly ignorant of the use of a map or a compass, and has no knowledge of guiding himself by the stars. The richer Persians carry compasses to show them the bearing of Mecca, so that they may bow themselves in that direction when saying their prayers, but they never use such compass for any other purpose.

My own life and that of my two Persian companions was saved by the Company's line in December, 1880, when caught in a snow-storm in the neighbourhood of Zenjan. The details of our escape are too long to give here, but the lesson it taught was never to travel at night in snowy weather if you can help it, and if you must so travel, and there is a telegraph line in your direction, stick to it. Though to follow it may mean leaving the road for ever so great a distance, you had better keep to the telegraph line, even at the risk of your own and your horse's neck.

At Ispahan, Her Britannic Majesty's Consul and the bankers are the only Europeans who are located in the city itself. The telegraph-office and the residences of the merchants are in the Armenian suburb of Djulfa.

The climate of this place is the finest in Persia, and surrounded by a Christian community, the telegraph officials have a very good time. The office-yard at Djulfa was thronged in March, 1890, by bands of affrighted Babis seeking sanctuary from their fanatical oppressors. A great many of this sect were ruthlessly butchered between their native villages and Djulfa on this occasion.

The governor of the city of Ispahan and the surrounding districts is his Royal Highness the Zil-es-Sultan, who is the Shah's eldest son, but is not the heir to the throne. He at one time devoted much of his energy and money to the formation of a division, comprising troops of all arms; and when this military zeal was at its zenith, about 1886, an artillery range was laid out across the Indo-European Telegraph line and the main road to Shiraz in such a way that the target was some 200 yards behind the wires. Thus, a gunner firing at a very slightly enhanced elevation would have cut one or more of them, and have run the danger of killing any stray traveller who might be following the track to Shiraz. The question had to be referred to his Royal Highness, who considered that we were faddists in that we requested that the practice on the range might be discontinued.

When high officials are capable of entertaining such ideas, it is not to be wondered at that ordinary individuals, without asking permission, or giving the slightest warning, should plant trees and build houses directly under the line; and as a Persian building of sun-dried bricks can be run up in a few days to the height of our lowest wire, the bad working of that wire has frequently, owing to its contact with the newly-built mud house, been the first intimation to us of the necessity for altering the line. There are no municipal or highway laws—in fact, there is no written code of any description; all questions are settled by the will of the local Governor, and as he is liable to be changed every 21st March—on which date all governorships have to be renewed—it may be imagined what trouble there is in protecting the telegraph line from molestation by ignorant and careless people.

I do not wish it to be inferred that the amount of wilful damage now done to the line is excessive; as a matter of fact, it is not greater than would occur to a line of the same length traversing an equally populated portion of Europe.

An arrangement was come to in 1880, by which compensation for wilful damage was to be deducted from the annual subsidy paid to the Shah for the use as a telegraph station of the promontory of Jask. By means of this agreement an endless amount of worry and trouble has been spared to the director of telegraphs.

From Ispahan to the water-shed at Dehbid, the line runs in a south-easterly direction, and is protected by mountain ranges. Koomeshah

is the head-quarters of the inspector of the second sub-section, which extends from Ispahan to Meshad-i-Moorgab, a distance of 195 miles. This inspector and his working parties are liable to annoyance from robbers who infest this part of the road at times of political disturbance, such as that which occurred in 1892. The bands especially affect the boundary between the province of Fars and that of Iran, knowing, that if they rob in the one province, and fly into the other, or *vice versa*, the Governor of the one province will leave the apprehension of the culprit to the other, and neither will hold himself responsible for the payment of compensation, or seriously attempt to put down the nuisance.

From the water-shed near Dehbid the country slopes down to the plain of Persepolis, and the line runs in a direction north and south; passing the tomb of Cyrus, it follows the course of the Pulvar river. The rocky gorges through which the river flows were the scenes of some of the heaviest breaks the line has ever received. The snow-drifts are tremendous, and frequently caused an interruption of a week's duration. It was near Meshad-i-Moorgab that Sergeant Hamilton met his death owing to exposure incurred in repairing a break which happened to a portion of the line, for the overhauling of which funds had not been available. This occurred in 1886. Since then, little by little, this portion of the line has also been improved, experience showing where its direction should be altered with advantage, the standards being strengthened by means of stays placed in the direction of the line itself.

Europeans and Persians, who have to go out on interruption duty, suffer greatly from the hardships they undergo. Persian gholams, or line riders, follow the Englishmen with the utmost devotion. To show what determined men they are, and how they remain in the service as long as possible, I may mention that, up to 1893, only one gholam had lived to enjoy a pension—he having been disabled by snow-blindness—others who have not died in harness have, on resigning, not survived to draw the pension they have earned. There is, however, one man now drawing a superannuation pension, and he is the first that has done so.

The line passes within two miles of the ruins of Persepolis, and forty miles further on Shiraz is reached.

The people of this city are a high-spirited, turbulent set; faction fights are of frequent occurrence among them. An old palace does duty as telegraph-office, one end being occu-

piéd by the British, and the other by the Persian administration. A square in front of the palace is a favourite site for political and other disturbances. In 1885, there was a serious rising, due to local politics. In 1891, there was one, directed by Syad Ali Akbar, against the institution of the tobacco regie. In 1893, the whole of the people revolted against the reinstallation of the hereditary Mayor. This man had oppressed the whole of the settled population of Fars, and his adherents had laid waste that province, even daring to lay seige to the city of Bander-abbas.

When a disturbance breaks out, the first point generally made for is the Persian Telegraph-office. The popular leader demands that a petition embodying the wrongs of the citizens shall be dispatched to the Shah. If a reply is not quickly forthcoming, the mob usually ousts the Persian telegraph officials and wrecks the office, or, at all events, renders the instruments useless. A move is then made for the British office, and a message is dictated to the superintendent, who has to forward it to the director in Teheran, who hands copies of it to her Britannic Majesty's Minister, the Grand Vizier, and the Persian Minister of Telegraphs, and consults with them with a view to obtaining protection for his staff. The senior British telegraph official at the sending station then becomes practically a hostage in the hands of the mob. In the very serious riot which took place in the spring of 1893, Mr. Fargues, the superintendent, was so detained, and was not allowed to leave the office precincts for five days. The local Governor was powerless to afford protection, what troops he had having fraternised with the insurgents. Mr. Fargues deserves great credit for the clever way in which he arranged this difficulty. Not a moment's delay occurred to the international messages, and not the slightest damage was done to the British office on this occasion.

When the people in Teheran, in the autumn of 1891, rose in revolt against the tobacco regie, they demanded the disestablishment of, not only that, but of all European institutions, with the exception of the telegraph department, which was exempted by name.

Our medical officers do much to win the good will of the inhabitants. The honest dealings, quiet lives, charitable actions of our men stationed in outlying posts, do a great deal in that respect. The Hon. George Curzon, in the last chapter of his book, describes as prodigious

the civilising effect of the Indo-European telegraph in Persia.

There is one solitary instance of the *personnel* of the telegraph department being made to suffer with the object of attaining political ends. The case occurred at Shiraz. A telegraph official, with his wife and friend, were set upon one evening, when proceeding from the telegraph quarters to the city; the ruffians fired on the party, and then made off, the lady was seriously wounded, the culprits were never discovered, but their object evidently was to discredit the Governor who then ruled in Shiraz. Compensation was paid, and much regret expressed for the dastardly outrage by the Governor.

It was from Shiraz that Mr. J. R. Preece was despatched in January, 1884, to report on the practicability of a land line *via* Darab, Forg, Tarum to Bundur Abbas, a distance of 550 miles, and the country between that place and Jask. He found no physical obstacles to such a line, which, if constructed, would complete an aerial wire from India to the North Sea.

When a line to link Jask, by land, to the Persian section is again under consideration it would be well to have the country between Kazerun and Bunder Abbas surveyed. It is probable that a very suitable way will be found along the southern slopes of the great mountains which form the boundary of the Persian plateau in that direction. The advantage of this route would be its freedom from snow and its close proximity to the gulf and to British influence.

From Kazerun to Behbaham, and thence to Ahwaz and Bagdad, would be the best route for a line to join up with the Mediterranean cables *via* the Euphrates valley. The country from Kazerun to Ahwaz is perfect for the purpose, and I must say that it seems to me that the Euphrates valley and Southern Persia is the best route for another line of telegraphic communication with India.

The third sub-section extends from Meshad-i-Moorgab to Mian-Kotul, a distance of 131 miles. The portion of this section which is south of Shiraz, is the one where the snow fall is greatest; the damp clouds from the Gulf discharge themselves in the winter in this elevated country.

The inspector and his gholams have to be proficient in the use of snow shoes. The pass by which the plateau is left has an altitude of 7,400 feet, while the surrounding mountains rise to 9,000 to 10,000 feet. The oak forest, and the lions and other wild beasts which still inhabit them, have often been described.

The fourth section extends from Mian-Kotul to the sea, and is the only one which is below the winter snow line—distance 102 miles. The total length of line is 675 miles.

No physical difficulties for a telegraph line exist. The inhabitants, however, are very troublesome. They still continue to damage the standards by using them as targets to test the penetrating power of their rifles. They are addicted to vendetta, and neighbouring villages are often at deadly feud. Those of Daliki and Borasjun are an instance in point. Mr. Arshak Malcolm, an Armenian, who died of cholera at Borasjun last year, was more than once obliged to call in his line guards for his own protection, and having shut up his office, had to remain on the defensive, whilst opposing factions fought it out around him. The heat, the flies, the earthquakes, and the cruel passes which are met with between Kazerun and the sea are a terror to all travellers.

The Persian section ends at Reshire, the work being there taken up by the Persian Gulf cables, which until last year were under the direction of Mr. Finch, who is now director-in-chief of the whole system.

The importance of the Persian Gulf to British interest must be well known to this audience. It has been the hunting-ground of British and Dutch traders since the expulsion of the Portuguese in 1622. Since the commencement of this century the police duties of this inland sea have been undertaken by Great Britain alone, and the repression of piracy rendered its water-ways practically safe as early as 1820.

The expense thus incurred has been recouped, as 90 per cent. of the trade of the Gulf is now in the British hands, and it affords a safe way for her telegraph cables. It is to be hoped that the British Government have everything prepared, and are ready to act for the protection of Southern Persia in any emergency.

With regard to the lines of the Persian Government, the first was erected from Teheran to Sultanieh in 1859, but it was demolished within the year. Next a line was made from Tabriz to Teheran in 1860, and was continued to the Russian frontier in 1863. In 1864 the Persians were able to utilise their powers and work over the English Government line from Bushire to Teheran, and on to the Turkish frontier at Khanegin. Year after year new lines were opened, till in 1877 the Persian Government lines were as follows:—

LINES.	Length in English miles.	Date of Completion.
1. Teheran to Bushire (English Government line of three wires; one wire is reserved for Persian traffic)	675	1864
2. Teheran to Khanegin (constructed by English Government; handed over to Persian Government, 1870)	440	1864
3. Teheran to Summer Palaces of H.I.M. the Shah	18	1865-67
4. Kasvin to Resht	105	1869
5. Teheran to Djulfa (Russian frontier); constructed by Siemens; three wires, one reserved for Persian traffic	415	1870
6. Teheran to Sháhrúd and Astrabad	314	1870
7. Merend to Khoi	35	1872
8. Hamadan to Dowletabad, Burujird, Sultánábád	120	1874
Total length of lines	2,122	....

The map (p. 541) shows what a number of lines have been since erected. The Turkish lines have been joined at Bashkaleh and Kanigin; those of Russia at Astra, *viâ* Resht; and those of the Trans-Caspian system *viâ* Astrabad and Sarakhs. Excepting a small part near the Turkish frontier, all the lines are carried by wooden poles, unseasoned poplar being the material most usually employed. These, of course, become rotten in a very short time, and are peculiarly liable to destruction by white ants. Struts are never used; wire stays are often placed within a few inches of a practically uninsulated line, and thus afford a fruitful source of leakage. There are very few insulators; those fixed are of various patterns; most of them have been made at Teheran, and all of them are practically useless; at all events in wet weather the lines will not work. On dewy nights they also would be unworkable; but as the offices only remain open during the day, this does not matter.

The instruments are of all sorts of patterns, but the greater number are sounders with polarized relays. Of the above lines, the only ones that are reliable and efficient are those maintained for the Persian Government by the European administration, namely, that from the Russian frontier to Teheran, that from Teheran to Bushire, and from Teheran to Meshad.

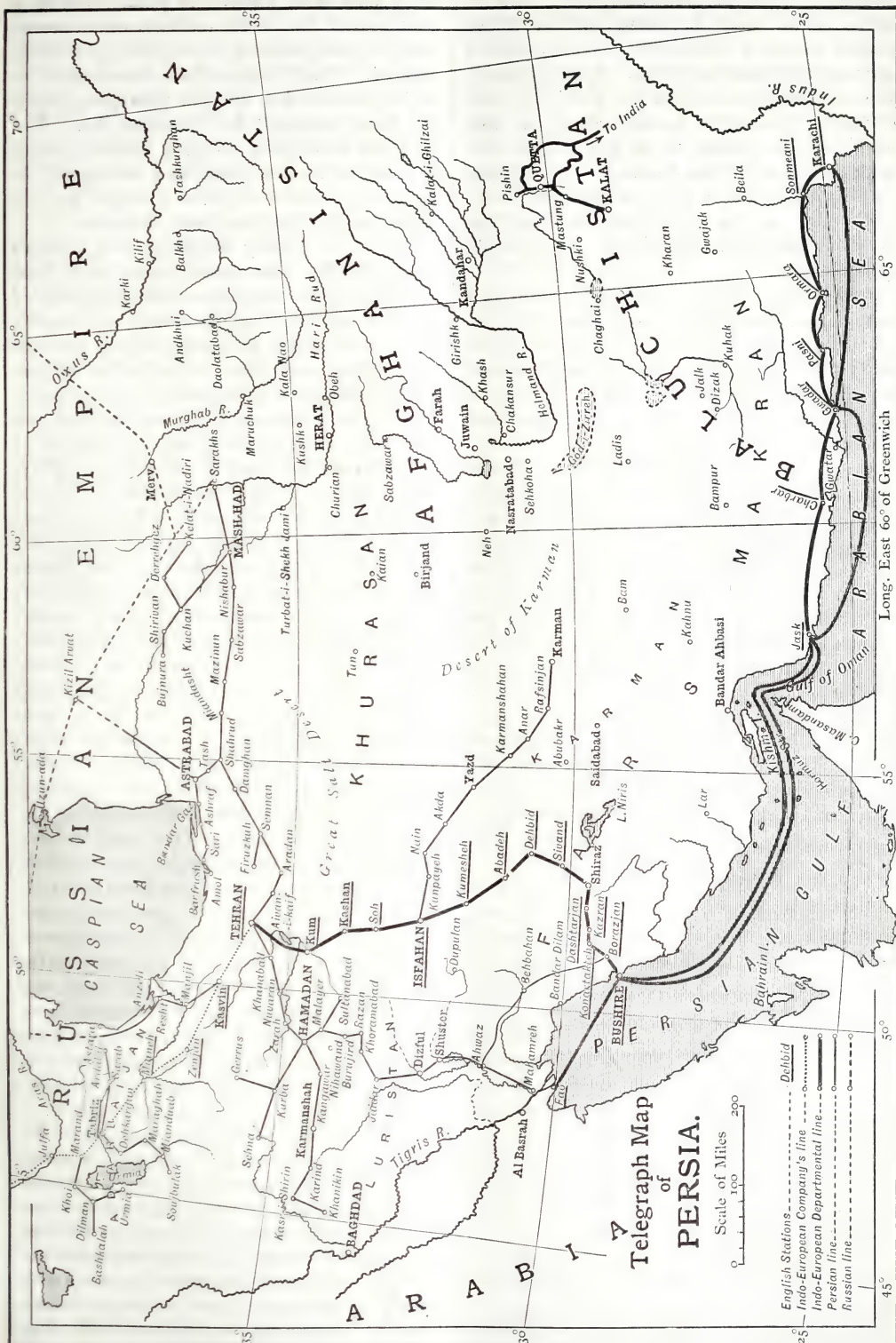
Besides the wires kept up by European administration, I have seen the following lines:—

1. In 1882, the line from Shuster to Dizful.
2. In 1883, and on many subsequent occasions, the line from Teheran to Rescht.

3. In 1888, the line from Bagdad to Teheran.
4. In 1891, the line from Kouchan to Meshad, and thence to Teheran.

The first, when I saw it, was a mere travesty of a line, supported on crooked sticks cut from brushwood, which scarcely kept it clear of the ground. Its course zigzagged across the country in erratic manner. Communication with Teheran had been interrupted for two years. The Lurs, a troublesome tribe of Nomads, who haunt the neighbourhood of Burujird, were mainly responsible for this; and the fact that they present an insurmountable difficulty to the keeping up of a line of telegraph in this direction is proved by the administration having, in 1890, abandoned the line *viâ* Burujird, and gone to the expense of erecting a new line from Borasjun *viâ* Behbahan to Ahwaz, so as to get touch with the Karun river, sending branches northward to Shuster, and southward to Mohammereh, along that river. For this last-named line, stores and instruments were obtained on payment from the Government of India; Zanzibar timber (which is impervious to white ants) is used for the poles. Of the second line mentioned, viz., from Kasvin to the Caspian, it is sufficient to say that over and over again travellers who telegraph from Rescht, announcing their departure for Teheran, arrive at their destination before their despatches are handed in.

A friend of mine told me that once, when he was going to Rescht, he found that the wire at Kasvin had been interrupted for two days; three stages forward he met a man on foot with a coil of wire who was then starting to repair it. The grave difficulties under which the Persian Government Telegraph Department labour



are—1st, want of education; 2nd, want of public spirit and discipline; 3rd, want of proper pay and promotion; and 4th, want of a proper system of inspection. His excellency, the Mukhber-ed-Dowleh, K.C.I.E., the Persian Minister for Telegraphs, is an able man, who is anxious to do the best he can with the means at his disposal. It is thanks to his good will and never-tiring exertions for the welfare of the Indo-European lines that they have achieved such success in the Shah's dominions.

On the Bagdad-Teheran line for miles the wire has no insulators. At one place I counted as many as nine joints in the wire in a length of 83 yards. The joints are shamefully made; are absolutely innocent of solder; the wire is simply twisted by the fingers, and often rests on the ground.

Occasionally poles that have rotted at the bottom are shortened and replaced, and thus have only a height, say, of 7 feet. Sometimes, where the wire had fallen out of the insulator, it was found spiked to the pole, just as high as the ghulam could reach. Thus a saving of labour in climbing the pole is secured at the expense of affording a dangerous obstacle to a horseman should he wander off the track at night.

The instruments and batteries seen were, for the most part, in a disgracefully dirty condition, and some of the operators were evidently addicted to smoking opium. At Kermanshah, which was reached on May 12th, 1888, communication with Teheran had been restored after ten days' interruption.

The Teheran-Meshad line was in a precisely similar condition prior to 1885. At that date the Government of India voted a liberal sum of money, and two European inspectors and two European clerks were deputed to try and put it into some sort of order so that it might meet the requirements of the Afghan Boundary Commission. Their efforts were very successful, and the thanks of Sir West Ridgeway, together with money rewards and medals, were given to the telegraph staff.

In 1886, it was decided by the Government of India to give an annual grant of 20,000 rupees to defray the salaries of a European inspector and two European clerks.

Little by little the director has been compelled to obtain the authority over the Persian clerks and gholams, by becoming the channel through which they obtain their pay from the Persian Government. Many of these clerks had previously been in the receipt of no fixed

pay; they were allowed to make what they could out of the traffic receipts, which meant that, in some isolated places, they practically starved. Many interruptions were caused by their ignorance and by their misappropriating the funds supplied for batteries, &c. The gholams were often so poor that they could not possibly keep a horse, and were forced to turn shop-keepers or follow a trade, instead of devoting all their time to their duties.

It may be readily imagined that, prior to 1885, this line was oftener unworkable than workable. Gradually, by substituting poles of cyprus wood—which white ants do not touch—for those of poplar, by cutting out the bad wire and making good joints, fitting up the offices, and renewing the instruments, and, by transferring the utterly worthless members of the staff, the period of interruption has been reduced from 1,600 hours in 1887 to 543 in 1893.

The system of dual control, which is now producing results with which H.I.M. the Shah expresses himself highly pleased, is feasible, thanks to the large-mindedness and liberal spirit of his Excellency the Mukhber-ed-Dowleh. The line suffers most severely from camels. These animals, when casting their coats in the autumn, go for the telegraph line. Their apathetic keepers never think of protecting Government property, and so it is only a matter of time ere the poles are effectually loosened, or even thrown down. Nothing but iron standards, with spreading foot-plates, will overcome this difficulty. Instances have occurred of the soldiers of a regiment on the line of march from Meshad helping themselves to telegraph poles in default of other fuel. As there is no arrangement, except one on paper, by which the local governors are made responsible for the safety of the line, it is at present impossible to obtain any protection for it: any passing traveller who wants a bit of wire helps himself from the line; anyone who wants wrought iron helps himself by smashing an insulator, and taking the bulk, 2,000 insulators per annum are so smashed.

If this line is to be kept up, and in the future prolonged through Herat and Candahar to the British frontier at Chaman, it must be entirely reconstructed with Siemens's iron standards ere it can be considered an efficient or thoroughly reliable means of communication.

I will now describe what has happened with regard to the trade routes in Persia since I have been personally acquainted with that country.

Already, in 1885, there was evidence of a

compact having been come to between the Russian and Persian Governments for the construction of a road from the Trans-Caspian Railway at Askabad to Meshad, *via* Kuchan, a distance of 188 miles. It took until 1892 for this work to be completed; that is to say, for the road to be passable for wheeled traffic throughout its whole length.

The route was traversed by me in 1890. The portion from Askabad up to the Persian frontier had been duly completed by the Russian Government. The gradients, however, were steep, and the zig-zags sharp. On the Persian side there was much remaining to be done, and long lengths through the mountains were still incomplete.

From Kuchan to Meshad, where the road traverses an alluvial country, no attempt at metalling had been made. The bridges were so badly constructed, that it was far safer to avoid them than to cross them.

For long distances, vehicles took to the fields in preference to following the cut-up mud which constituted the track. In an open country, the marking out of a track by digging a ditch on either side, constitutes, in the eyes of the modern Persians, the making of a road. The ancient Persians certainly constructed paved causeways and grand bridges, but with the Arab conquest apparently wheeled traffic disappeared, with all ideas of road-making. This road, such as it is, has materially facilitated and expedited communication between Khorassan and the Trans-Caspian railway.

Kuchan, during last autumn, was destroyed by an earthquake. A letter dated February 1st, 1894, Meshad, states that the first-named town is level with the ground; not a building is intact: tops of hills have been levelled down; 8,000 people and 20,000 animals are known to have been destroyed. What the effect will be of this destruction on the commercial success of this road remains to be seen.

The main avenue by which Teheran is reached from Europe has had nothing done to improve its conditions since 1880.

Starting from Pir-i-bazar some efforts are made to keep up a causeway for the eight miles to Resht. The next stage to Kudoom is in a fair state of repair, not so, however, the next two stages which follow the left bank of the Sefid-rud river. The road here passing through the forest of Mazanderan, where the rainfall is, I should say, from 100 to 120 inches a year, is impassable for anything but a Persian pack animal during wet weather.

Going along these stages, after continuous

rain, I have often counted from five to six corpses of well-fed animals who have succumbed to the frightful exertion of slipping on mud banks and plunging through quagmires. The loss of life to animals on this road is something appalling.

The rocky passes beyond the rain belt are also very trying. The mules have to place their feet exactly in the places worn by countless animals, or be in danger of precipitation into space. The Sefid-rud is crossed by a bridge at Manjil, and the next stage is tolerably easy.

Then comes the Kazan Pass, with an altitude of 6,500 feet. This pass is open to the full blast of the snow-laden winds of the Caspian, and, consequently, is very dangerous in winter. Unfortunately for travellers, the telegraph line does not follow it, so there is nothing to guide them over its monotonous slopes when once the track has been hidden by snow. Eighteen men were lost on this pass in broad daylight in 1891, and never a winter passes without from fifteen to twenty being lost on it.

At Kasvin, with an altitude of 4,000 feet, situated 100 miles from Resht, vehicles are to be had to carry passengers and goods post haste to Teheran, a distance of 94 miles, over a road that has never been touched since it was marked out by the official trench some fifteen years ago. Luckily the country over which it passes is mostly stony.

When it is considered that the whole of the kerosene supply for Persia, and two-thirds of the trade between that country and Russia, traverses this road, the deplorable state it is in is simply astonishing.

Endless schemes for railways, &c., have been mooted since Baron Reuter proposed the original one in 1872. But nothing comes of them. The latest concession for a railway was given to a Russian-Jewish firm named Poliakoff some one and a-half years ago, and when bidding me good-bye a year ago, the Grand Vizier said, "When you return, you will travel from Resht by rail." Nothing has yet been done, nor, from what I can hear, is likely to be done.

The Meshad-i-sar route, which was opened up in 1880, has fallen into disuse from want of repair.

So much for the trade routes to the north. To the west, the Trebizond caravan route holds its own, and is that by which most European goods reach Azerbaijan and the north-west. The transit rates on the Trans-Caspian Rail-

way debar all ingress and egress to other than Russian goods by that route. The Baghdad-Kanegin route carries the exports and imports of the Kermanshah and Kurdistan districts to the Euphrates.

The next route is that of the Karun River. Every one will remember the great expectations raised by the announcement that at last the one navigable river in Persia had been opened to international traffic. There were sanguine people who talked of ocean-going steamers lying at Ahwaz, oblivious of the fact that for two months of the summer the Karun below Ahwaz has often only one foot six inches of water. Fast diligences were to run from Shuster to Teheran, doing the journey in six days.

There is, after all, a small trade in the Karun mostly carried on by local Persian merchants. The tramway, which I suggested in 1882 as a means for overcoming the difficulty presented by the natural barrier of rocks which obstructs the navigation at Ahwaz has actually been laid. When I revisited the river in 1890 there were two small steamers above the barrier and one large one plying on the lower Karun.

The road to connect the river with Teheran and central Persia has practically come to nought. In 1890, a concession was procured by the Imperial Bank of Persia, authorising the making of a road *viâ* Ahwaz, Shuster, Dizful, Khorranabad, and Burujird to Teheran, which was to have the advantage of being 250 miles shorter than the better known route *viâ* Shiraz, Ispahan, and Kashan.

Engineers were brought out, and the work put in hand in a vigorous manner, but unfortunately a commencement was made at the wrong end. Whether it was with a view of impressing the Shah with the seriousness of the undertaking, or whether with a view of pleasing the Grand Vizier by taking off his hands the 96 miles of road from Teheran to Kum, which was probably not paying over well—to which road I alluded in the first part of this paper—I am unaware. But this is certain, that £86,000 was spent in putting those 96 miles in thorough order, and pushing on an unmetalled road to Sultanabad, where it now ends in space, leading to nowhere.

It must be remembered that this Ahwaz, Khorranabad, Burujird route was a line unknown to muleteers, save by the bad reputation held by the Lurs, through whose country it passed. From Burujird to Kum and Tehe-

ran was more or less plain sailing, and country known to the most ignorant Persians.

I cannot, therefore, help thinking that had that £86,000 been spent in subsidising the Lurs, instituting ferries, and building caravan serais from Shuster to Burujird, trade might have been tempted to make a way for itself thence to Teheran, and little by little a road company would have been possible. It is very sad that so much energy and expenditure has been wasted. Had but the £86,000 been spent on the road from Bushire to Shiraz, I am confident that it would have revolutionised the trade on that route, and that we should have had fourgons travelling from Dushire to Kum at all events by this time.

The improvement of the Bushire road still attracts fitfully the notice of the Persians themselves. His Excellency the Nizam-es-Sultanah, who was for some time Governor of Bushire and Mohammerah, and who during the past year was Governor of Shiraz, never saw me without asking the loan of an engineer, to make an estimate for putting the road in order. The engineer is always forthcoming, the estimate is always ready, but the serious undertaking of the business is ever postponed.

There only remains the Bunder-abbas route to Kirman, which is notorious for the difficulties of its passes, which rise at some points to nearly ten thousand feet above the sea. These are impassable for weeks at a time in winter. This route has not changed since the days of Marco Polo. All traffic on it was stopped by the rebels, who besieged the city of Bunder-abbas during the winter of 1892-93, as already narrated.

The present rate of freight from Bushire to Teheran is 600 kraus per ton. Taking the rate of exchange at 50 kraus to £1 sterling, brings this to £12 per ton. The distance from Bushire to Teheran, say 750 miles by road, so that goods cost 3·84 pence per ton per mile.

APPENDIX A.

LENGTH OF SUBSECTIONS OF PERSIAN SECTION.

	miles.
1. Teheran to Ispahan.....	247
2. Ispahan to Meshed-i-Murghab ..	195
3. Meshed-i-Murghab to Mean Kotul	131
4. Mean Kotul to Bushire	102

AVERAGE SPEED OF MESSAGES BETWEEN
TEHERAN AND BUSHIRE.

	Teheran to Bushire.	Bushire to Teheran.
	M. SEC.	M. SEC.
1880-81	3 54	Not given.
1881-82	11 4	"
1882-83	12 13	5 13
1883-84	5 9	4 29
1884-85	15 6	14 5
1885-86	40 28	13 37
1886-87	13 0	8 21
1887-88	6 42	4 45
1888-89	17 42	4 57
1889-90	6 9	4 34
1890-91	3 54	6 40
1891-92 }	Reports not received from India.	
1892-93 }		

AVERAGE SPEED OF MESSAGES BETWEEN
UNITED KINGDOM AND CALCUTTA.

	Via Teheran.	Via Suez.
	H. M.	H. M.
1880-81	1 18	2 22
1881-82	1 33	3 33
1882-83	4 27	4 55
1883-84	1 34	3 5
1884-85	1 57	3 14
1885-86	3 42	3 36
1886-87	1 31	2 31
1887-88	1 11	2 42
1888-89	2 24	3 2
1889-90	1 5	2 21
1890-91	1 10	2 14
1891-92	1 3	1 31
1892-93	0 53	1 32

APPENDIX B.

I.E. TELEGRAPH SYSTEM. TOTAL INTERRUPTIONS.

	I. E. Co.	Persian Section.	P. G. Section.	Deduct for Simultaneous Interruptions.	Total Interruption.
	D. H. M.	D. H. M.	D. H. M.	D. H. M.	D. H. M.
1879-80	15 9 47	0 4 40	—	—	15 14 27
1880-81	6 22 52	7 19 55	—	—	14 18 47
1881-82	79 11 16	2 14 8	9 5 53	10 15 31	80 15 46*
1882-83	29 10 16	1 4 31	5 18 24	—	36 9 11
1883-84	9 7 11	0 13 41	17 1 30	0 13 18	24 9 4
1884-85	6 3 17	13 11 42	5 19 0	1 11 50	23 22 9
1885-86	8 5 30	15 17 48	10 9 0	—	34 8 18
1886-87	4 17 11	2 11 23	—	—	7 4 34
1887-88	66 11 59	0 9 0	0 8 59	—	67 5 58*
1888-89	44 0 0	2 2 46	—	—	46 2 46
1889-90	8 19 37	0 22 58	—	—	9 18 35
1890-91	8 10 38	1 17 40	—	—	10 4 18
1891-92	3 4 4	0 5 0	—	—	3 9 4
1892-93	5 21 40	—	—	—	5 21 40

* North Sea cable broken.

DISCUSSION.

Mr. T. H. THORNTON, C.S.I., said that he had listened with the greatest interest to the account given on telegraphs and trade routes in Persia, an account which had been so well written by Colonel Wells, and he might add so well read by Mr. Mc Calmont Hill, and illustrated by such excellent photographic views. When they heard of the great physical difficulties that had to be encountered, the character

of the inhabitants, and the character of the Government, they must feel proud of their countrymen and those who had worked with them in constructing and protecting these important means of communication. He had heard, with very great interest, the testimony borne to the excellent effect of the action of the medical officers, and to the honest dealing, quiet lives, and charitable actions of Englishmen stationed in outlying posts. With regard to trade routes, he

was afraid the accounts given were not very encouraging, but it was important as showing how the matter stood.

The CHAIRMAN said that as a very old inhabitant of, and traveller in Persia, he might be permitted to say a few words of his own experience of the subject brought before them. He could not help feeling that it was appropriate on the present occasion to refer a little to the origin of the telegraph in Persia which had been carried out so successfully in later years. Colonel Wells had continued excellently the work of his predecessors. He had not, himself, the slightest claim to be a scientific man; he had no knowledge of engineering or telegraphs, but it had been his lot to be at the head of the telegraphic department for five years, and almost at the outset of operations. That position, although it did not enable him to talk of the science of telegraphy, did enable him to bear testimony to the admirable conduct of the officers who had been employed with and under him. The recollection of work which they had performed was vividly before him, and he considered there could not be a finer set of officers and Englishmen found in the world than those who had set up and maintained the telegraph in Persia. It was his lot to be associated with Colonel Patrick Stewart when he started with the cable from Kurrachee in 1864. When they met at that station, he was fired with the idea of being of use to him in carrying out the telegraphic scheme; and although just appointed Collector of the District, he said, "Can you give me anything to do?" Colonel Stewart telegraphed to Bombay at once, and suggested that he (the Chairman) should go with him on the expedition. The Governor telegraphed back his consent, and with that *carte blanche* he started off as what might be considered the political officer of the expedition. Later on, he was asked to undertake an inspection of the whole of the lines between the head of the Persian Gulf and Ismid, where he was on a new field of work. At Constantinople, Patrick Stewart died from overwork, and at his death he (the Chairman) was ordered to succeed to the directorship, notwithstanding his protest that he knew nothing of scientific telegraphy. He was told that he was wanted for quasi-political duties, and that as regards the *technique* he had a splendid staff under him. He could not take any credit to himself for carrying out the line, which was really done by the engineer officers with whom he was associated, namely, in the first instance, Patrick Stewart (afterwards Sir John Champaign), Sir Oliver St. John, and William Henry Pearson, one of the most accomplished and intelligent officers he had ever met. The officers he had named had, unfortunately, all passed away, and therefore he might perhaps be pardoned for paying a little tribute to their memory. When he looked back, and remembered the time when there was no telegraphic communica-

tion between India and England, he could not help observing that they owed a debt of gratitude to the memory of those who had constructed it. When the telegraph was first instituted, it was impossible to realise how great were the difficulties. The Persians did not understand European ways and customs, and it was very difficult to get them to do what was wanted. He remembered on one occasion, in Beluchistan, that a native was persuaded to send a message by wire, but when the reply came, he maintained that the whole thing was an invention. Fortunately, such things were now changed. Failure to complete the land working, at the outset, had dissatisfied commercial men in England; the Red Sea cable was laid; but new land lines were erected, which worked as well as the cable, and all the prophecies that overland communication would be an impossibility had come to nothing. In conclusion, he begged to propose a hearty vote of thanks to Colonel Wells and to the reader of the paper.

The resolution having been carried,

Mr. McCALMONT HILL, acknowledged the vote, and the meeting adjourned.

General Notes.

HOBART INTERNATIONAL EXHIBITION. — The Queen has appointed a Royal Commission to take all necessary steps in furtherance of this exhibition. The Commissioners are the Marquis of Ripon, K.G., president, Lord Herschell, G.C.B., Lord Chancellor, Lord Knutsford, G.C.M.G., late Secretary of State for the Colonies, Sir Frederick Leighton, president of the Royal Academy, Sir R. G. Wyndham Herbert, G.C.B., Agent-General for Tasmania, and late Permanent Under Secretary for the Colonies, Lieut.-Gen. Sir Andrew Clarke, G.C.M.G., Sir Robert G. C. Hamilton, K.C.B., late Governor of Tasmania, and Mr. Sydney Buxton, M.P., Parliamentary Under Secretary for the Colonies; the secretary is Mr. G. Collins Levey, C.M.G., and the offices are at those of the Tasmanian Government, 5, Victoria-street, S.W. The first meeting of the Royal Commissioners was held on Tuesday, 8th inst., and it was decided to ask the assistance and co-operation of the Lord Mayors and Lord Provosts, the mayors and provosts of the United Kingdom, and the chambers of commerce, to bring the exhibition under the notice of the free libraries of the United Kingdom, and to take steps for the proper representation of British art.

CORRECTION.—Page 511, col. 2, line 37, for 2 per cent. and 5 per cent., read 2 per cent. and .5 per cent.

Journal of the Society of Arts.

No. 2,165. VOL. XLII.

FRIDAY, MAY 18, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CONVERSAZIONE.

The Society's *conversazione* will take place at the Imperial Institute, South Kensington (by permission of the Council of the Institute), on Friday evening, June 22, from 9 to 12 p.m.

The reception will be held from 9 to 10 p.m., in the vestibule, by Sir Richard Webster, G.C.M.G., Q.C., M.P., Chairman; Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Deputy-Chairman, and the members of the Council of the Society.

Each member will receive a card for himself, which will not be transferable, and a card for a lady. A limited number of tickets will be sold to members of the Society, for the use of their friends, at a charge of five shillings each, if purchased before Saturday, 16th June.

Further particulars as to the arrangements will be given in future numbers of the *Journal*.

PRACTICAL EXAMINATION IN VOCAL AND INSTRUMENTAL MUSIC.

The next examinations will be held by Sir Joseph Barnby, Principal of the Guildhall School of Music, and W. G. McNaught, Esq., A.R.A.M., joint Examiners, at the House of the Society of Arts, and will commence on Monday, 11th of June. The Examination will be Vocal and Instrumental, and there will be two grades, First-class and Second-class. No names can be received after Monday, 21st inst.

Full particulars can be obtained on application to the Society.

PRIZE FOR DESIGN FOR A SILVER CUP.

The Council of the Society are prepared to award a prize of £25 for the best design for a silver cup. The design, if adopted, will be used for the Swiney prize, which, under the will of the late Dr. Swiney, is awarded every five years by the Society for "The best published work on Jurisprudence." The value of the cup is £100. The offer is open to all students of schools of art in the United Kingdom. Competing designs should be sent in not later than the 31st December, 1894, addressed to The Secretary, Society of Arts, Adelphi, London. They may be sent in under a motto, or in the competitor's name, as preferred. Any design for which the prize of £25 may be awarded will become the property of the Society, to be used as the Council of the Society may direct. The Council reserves the right of withholding the prize, or of awarding a smaller amount, if it should see fit.

INSTITUTIONS IN UNION.

The following institution has been admitted into Union with the Society since the last announcement:—

Free Public Library, Oldham.

Chicago Exhibition, 1893.

MEETING OF THE ROYAL COMMISSION.

A meeting of the Royal Commission was held on Thursday, 10th inst. Present:—Sir Richard Webster, G.C.M.G., Q.C., M.P., in the chair; Sir Frederick Abel, Bart., K.C.B., D.C.L., D.Sc., F.R.S., Sir George Birdwood, K.C.I.E., C.S.I., LL.D., M.D., G. Ledgard Bristow, Major-General Sir Owen Tudor Burne, K.C.S.I., C.I.E., Michael Carteighe, R. Brudenell Carter, F.R.C.S., Francis Cobb, Sir Henry Doulton, James Dredge, Florence O'Driscoll, M.P., Prof. Francis Elgar, LL.D., Prof. Clement Le Neve Foster, D.Sc., F.R.S., Sir Douglas Galton, K.C.B., D.C.L., F.R.S., Walter H. Harris, John Biddulph Martin, John O'Connor, B.L., Sir Westby B. Perceval, K.C.M.G., Professor William Chandler Roberts-Austen, C.B., F.R.S., with Sir Henry Trueman Wood, M.A., Secretary to the Royal Commission.

CHICAGO EXHIBITION, 1893.

BRITISH SECTION.

Report of the Royal Commission for the Chicago Exhibition.

I.—ORGANISATION OF THE ROYAL COMMISSION.

In March, 1891, Mr. Robert Lincoln, who was then American Minister to Great Britain, reported to the Marquis of Salisbury the proclamation of the President of the United States, inviting the countries of the world to take part in the "World's Columbian Exposition," which it had been determined to hold at Chicago in the year 1893, under conditions to which attention will be drawn in a later paragraph of this report, and made a formal application, on behalf of his Government, that this country should take part in the Exhibition. Mr. Lincoln at once received the reply that a Royal Commission should be appointed for the purpose.

No immediate action was taken, but as the result of some informal negotiations, the Under Secretary of State for Foreign Affairs, in June, 1891, applied to Sir Richard Webster (who was then Attorney-General), the Chairman of the Council of the Society of Arts, to know whether the Council of the Society would undertake the duties connected with the organisation of the British Section of the Chicago Exhibition, if a grant of £25,000 were appropriated by the Treasury for the purpose.

The proposal was, in the first instance, submitted to H.R.H. the Prince of Wales, the President of the Society, and was approved by him. The Council then went very carefully into the question, and came to the conclusion that if the exhibitors were willing, as in the case of the Paris Exhibition of 1889, to contribute towards the expenditure, the grant proposed might be made to suffice. They accordingly requested their Chairman to submit a memorandum stating the conditions on which they would be willing, on behalf of the Society, to undertake the proposed duties.

On the 9th July, Sir James Fergusson, as Under Secretary of State for Foreign Affairs, addressed a letter to Sir Richard Webster, stating that the Lords of the Treasury would accept the offer of the Society to undertake

the organisation of the British Section in Chicago in 1893, and that they had requested the Home-office to take the necessary steps for constituting the Council of the Society for the time being a Royal Commission* for this purpose.

Under the constitution of the Society of Arts its Council is changeable, a certain number of the Vice-Presidents and other members retiring annually, and being succeeded by others elected in their place. In order to retain on the Commission the retiring members, the Council proposed to a General Meeting, in 1892, that they should be empowered to nominate after the annual elections of 1892 and 1893, six additional Vice-Presidents, to hold office only until the election of 1894. The proposal was approved, and a resolution to that effect carried, and in each year duly acted upon.

Messrs. Wilson, Bristows, and Carpmael were good enough to undertake, at the request of the Commission, the duties of Honorary Solicitors—which duties they had also discharged for the British Committee of the Paris Exhibition in 1889. It has happened on several occasions that the Commission have had to consult them, and the services they rendered are here gratefully acknowledged.

Messrs. J. O. Chadwick and Son, who have been auditors to this Society of Arts for many years past, kindly took upon themselves the onerous duty of auditing the accounts of the Commission, and consented to act as Honorary Auditors. The accounts have been audited monthly by Messrs. Chadwick, and the guarantee thus furnished as to their accuracy has throughout been greatly valued by the Commission. They now tender their thanks to Messrs. Chadwick for their valuable and constant assistance.

The Commission was actually issued on the 26th August, 1891,† but in the meantime the Council of the Society had anticipated their

* A list of the members of the Commission is given in Appendix 2.

† The warrant is given in Appendix 1.

appointment by communicating with the India-office and the Colonial-office, and had requested that the British colonies and the Government of India might be informed of the action which Her Majesty's Government proposed to take with regard to the Chicago Exhibition.

They had also the pleasure of receiving the Special Commission sent over from the United States by the National Commission with the view of securing the co-operation of the various European Governments. This Commission, which consisted of the Hon. Benjamin Butterworth, Judge Lindsay, Mr. Ferdinand Peck, Major Handy, and Mr. W. H. Bullock, arrived in England in July, 1891. Their visit was of great value in providing information as to the general scope and character of the Exhibition, and of the organisation which was provided for carrying it out. In the report which they made on their return, they expressed in warm terms their appreciation of their reception here, and their belief that it largely contributed to the ultimate success of their mission.

The first meeting of the Royal Commission was held on the 3rd September, 1891. Since that date the Commission have held meetings, all of which have been numerous attended.

As soon as the necessary information had been obtained, circulars* were issued to those firms who had taken part in recent International Exhibitions, and to a large number of other firms who from their connections with America, or for other reasons, were likely to become exhibitors at Chicago, inviting them to take part in the Exhibition. In the preparations of the lists of persons to receive these circulars useful help was given by H.M. Consuls in the United States, who, at the request of the Foreign-office, returned the names of the English firms having business houses or representative agencies in the various consular districts. Communications were addressed to the mayors and provosts of all towns in the United Kingdom, and application was made to all the Chambers of Commerce asking them to distribute information throughout their districts, and in many cases suggesting the formation of collective exhibits, representing the industries of the locality. It is to be regretted that this system, so successfully adopted in France and Germany, does not appear to commend itself to English manu-

facturers. Special letters were sent to a selected number of manufacturers who for any reason were considered as likely to become exhibitors. Advertisements were also inserted in the principal English, Scotch, and Irish newspapers.* A little later a handbook was prepared and issued gratuitously. As this contained a great deal of useful information, there was a very large demand for it.†

The limited amount of the grant made by the Government, in the first instance, rendered it necessary that the amount should be supplemented by charges for the space occupied by exhibitors, and, indeed, the grant was made on that understanding. A sliding scale was therefore arranged, under which charges were made for space, the highest being 5s. per square foot of superficial area, the lowest 2s. 6d. per square foot; the amount varying according to the size of the space proposed to be occupied by the exhibitor.

The date by which all applications were to be received was fixed for the 29th February, 1892. In answer to the circular a large number of applications was received, though it was found that the high Customs' duties now levied in the United States deterred manufacturers in many important departments of industry from taking part in the Exhibition. Some objections were also taken to the charge for space, but these were not numerous.

When the vote on account came before the House of Commons in Committee of Supply, on the 17th March, 1892, great exception was taken to the small amount of the grant, and there was a strong expression of opinion, from all sides of the House, that the sum granted should be largely increased. The Commission felt themselves justified by this expression of feeling in urging upon the Chancellor of the Exchequer the desirability of placing a larger sum at their disposal, especially in view of the fact that the contributions of all the other great countries which proposed to take part in the Exhibition were on a much more liberal scale.‡ As a result of this application, the Chancellor of the Exchequer, on the 14th April, 1892, intimated that Her Majesty's Government were willing to increase the grant to the Royal Commission from £25,000 to £60,000, on the

* As soon as photographs of the buildings in progress could be obtained, lantern slides were made and lent for the purpose of local lectures. A good many of these were delivered at Institutions in Union with the Society of Arts and other Institutions.

† See § xxviii. of this Report.

‡ A list of the amounts granted by Foreign Governments is given in Appendix 13.

* In all about 25,000 circulars were issued.

understanding that space should be provided free to British exhibitors.

The natural result of this liberality on the part of the Government was a considerable increase in the number of applications; and much satisfaction was expressed at the decision of the Government. It was felt that British exhibitors would have been at a serious disadvantage, compared with those of other countries, had a payment for space been added to the very heavy charges which are of necessity incurred by exhibitors at a foreign Exhibition.

This alteration in the arrangements rendered necessary a fresh issue of circulars, and of advertisements, so that the work of communicating with possible exhibitors was a good deal heavier than in the case of former Exhibitions.

The number of applications for space in the Industrial Sections was 1,010; of these applications 625 were accepted, and space allotted to them. It was felt to be more desirable to give extended space to firms who were likely to represent adequately the industries of the country, than to divide up the space available into smaller allotments, and thus to satisfy all applicants. It was also considered that only such firms should be admitted as were likely to reflect credit on the country. Had a different course been pursued, the number of exhibitors might have been largely increased; but the display would not have reached the high standard it certainly attained.

It should be noted that, as in all recent Exhibitions, there were few official Government exhibits. In the earlier Exhibitions important contributions were sent from many Departments of State. Thus at Paris, in 1867, the Admiralty, the War-office, the Treasury, the Post-office, the Board of Trade, and the Science and Art Department, were all represented, and so were the Trinity-house and the Irish Committee of Fisheries. To Chicago, only the Post-office, the Science and Art Department, and the Ordnance and Geological Surveys sent exhibits. These contributions involved considerable expenditure, as all costs were borne by the Commission, and even had other Departments been willing to assist, the necessary funds could not have been provided out of the Government grant. In the case of foreign countries the official exhibits were in many instances among the most important contributions.

A statement of the expenditure is given as Appendix 11, while for the sake of comparison,

a summary of the expenditure of previous Exhibitions is given in Appendix 12.

II.—COMMITTEES.

In order to bring the Chicago Exhibition under the notice of manufacturers in the chief provincial centres of industry, and to assist generally in the work, the Commission appointed a certain number of committees. The subjects dealt with by the committees were—the Colonies, India, Agriculture and Food Products, Mines and Metallurgy, Engineering Architecture &c., Electricity, Transportation, General Manufactures, Textile Manufactures, Science and Education.* They also, at the outset of their proceedings, addressed an invitation to all the Chambers of Commerce in the United Kingdom, asking whether they would act as Local Committees for the Exhibition. From many of these a favourable response was received, and they undertook to disseminate information about the Exhibition.†

III.—AMERICAN COMMISSIONER FOR GREAT BRITAIN.

In order to assist in spreading information about the Exposition in England and in Europe, the American Executive, in the autumn of 1891, established an office in London in Victoria-street, and appointed Mr. Robert McCormick Commissioner for Great Britain. Mr. McCormick had for some time held the office of Second Secretary in the United States Legation in London, and was consequently well known, so that he was enabled usefully to co-operate with the Royal Commission in disseminating information as to the Exhibition, and in attracting attention thereto. On April 6, 1892, he read a paper on "The Future Trade Relations with Great Britain and the United States," and for it the Society awarded him a medal.‡ Mr. McCormick's mission terminated in the autumn of 1892, and the office was closed.

IV.—ORIGIN AND ORGANISATION OF THE EXHIBITION.

The idea of holding an International Exhibition at Chicago was not new, it

* A list of these committees is given in Appendix 3.

† A special local committee was formed for Ireland, consisting of representatives of the Corporation of Dublin, the Royal Dublin Society, and the Chamber of Commerce. Much valuable work was done by this committee and its energetic Secretary, Mr. T. Baker, by whose exertions many important additions were made to the list of Irish exhibitors. A list of these committees will be found in Appendix 4.

‡ *Journal of the Society of Arts*, vol. xl., pp. 523 and 755-

had been frequently discussed of late years in that city, but it had never attracted very serious attention till the success of the Paris Exhibition, in 1889, suggested, as a fitting manner of celebrating the 400th anniversary of the discovery of America by Columbus, the holding of a great International Exhibition, in 1892, a date afterwards postponed to 1893. The people of Chicago at once determined to ensure that their city should be selected as the site of the Exhibition, and for that purpose a committee was formed, which, later, developed into a corporation, "The World's Exposition of 1893,"* with a capital stock of \$5,000,000 (say £1,000,000).† In their efforts they were successful, and a vote taken in Congress on February 24, 1890, to decide as to the name of the city which should be inserted in the Bill authorising the holding of an Exhibition, gave the precedence to Chicago, New York being placed second, and St. Louis third.

This result was only obtained after the city had guaranteed that a sum of not less than \$10,000,000 should be expended on the purposes of the Exhibition. The Bill soon passed both Houses of Congress, and on April 28th, 1890, the President's signature was affixed to an Act authorising the holding of an International Exhibition at Chicago, to be called "The World's Columbian Exposition." This Act empowered the President to appoint a National Commission, which Commission had authority to accept a site offered by the city and approved by them, so soon as the amount of \$5,000,000 (£1,000,000) had been subscribed, and satisfactory guarantees given that another \$5,000,000 would be forthcoming as soon as it should be required.

The Act further empowered the President to make proclamation inviting the countries of the world to take part in the Exhibition. It allotted \$100,000 (£20,000) for the purposes of foreign exhibits, and \$1,500,000 (£300,000) for the erection of a building to contain exhibits from the various Departments of State, and for the arrangement of these collections. It also provided salaries for the

members of the Commission and their officers. It appointed a Board of Lady Managers to organise a special Exhibition of Women's Work, and to take charge of the interests of women in the Exhibition. It also provided for the payment of salaries to members of this Board.

The day for the opening of the Exhibition was fixed for the 1st of May, 1893, and the closing for October 30th.*

The Board of Lady Managers was formed on the 25th of June, 1890. It consisted of two representatives of each State. Mrs. Potter Palmer was President of the Board.†

The National Commission, which consisted of two Commissioners nominated by the Governor of each State, and sixteen others nominated by the President, met on the 25th of June, 1890, and appointed the Hon. T. W. Palmer (formerly senator for Michigan), as their President. The important appointment of a Director-General was deferred till the Autumn Session, when (in September, 1890) Colonel George R. Davis was elected. For a long time the question of the site of the Exhibition was discussed between them and the local Executive; but eventually they decided on the site, ultimately adopted, in Jackson-park; and having further satisfied themselves that the stipulated funds would be forthcoming, they notified the President of the United States accordingly.

The conditions laid down by the Act having thus been fulfilled, on December 24th, 1890, the President issued a proclamation to all Foreign Governments, inviting them to take part in the Exhibition.

It will be seen that there were two independent governing bodies, the National Commission, and the World's Columbian Exposition Company. This latter body was represented by a directorate of forty-five persons, elected by the stockholders of the company. The company had to lay out the grounds, erect the buildings, and, in fact, provide all that was required for the holding of the Exhibition. They transferred to the National Commission the park and buildings by the 21st October, 1892, for their formal adoption and dedication. Their functions, however, did not then cease, because all the financial control

* At a later date the title of the company was changed to "The World's Columbian Exposition," and the amount of stock increased to 10,000,000 dollars.

† For convenience dollars have been turned into sterling, at the rate of 5 dollars to the £1. The actual rate, subject to the usual variations of exchange, is about £1 = 4 dollars 85 cents. The *intrinsic* value of £1 sterling is 4 dollars 86 65/100 cents. It has been thought more convenient, as a rule, to give round figures only.

* The fixing of October 30th, instead of the 31st, appears to have been a clerical error, which escaped notice until the approval of the actual date itself, when complaints were made that the slip had deprived the executive of a day's receipts.

† Some notice of the work of the Lady Managers is given in a later part of this Report, § xxix.

of the Exposition remained in their hands, and they took all the receipts from admissions and other sources.

It was the duty of the National Commission to fill the buildings with exhibits, all dealings with Foreign Commissions on the one hand, and with American exhibitors on the other, being under their charge.

The first President of the Board of Directors was Mr. Lyman J. Gage. He held office from April, 1890, to April, 1891, when he retired on being elected to the presidency of the First National Bank at Chicago. He was succeeded by Mr. T. W. Baker, who was re-elected at the annual meeting of April, 1892, but retired in August of that year. He was followed by Mr. H. N. Higinbotham, who remained in office until the close of the Exhibition, and upon whose shoulders, therefore, fell the active work of the Presidency during the holding of the Exhibition itself. Mr. Ferdinand W. Peck served as Vice-President during Mr. Higinbotham's term of office, and on various occasions took the place of the President in his absence.

The inconvenience of the double control led to the appointment of a Board of Reference and Control, made up of representatives of both the Commission and the Directory. The place of this body was afterwards taken by the Council of Administration, similarly constituted.*

V.—JACKSON-PARK.

Jackson-park, which was finally selected as the site of the Exhibition, is situated on the shore of Lake Michigan, on the southern side of the city. The northern end of the park is distant from the Van Buren-street Station of the Illinois Central Railway (which may be looked upon as a fairly central point of the city), about six miles. The extreme length of the portion allocated to the purposes of the "World's Fair," the name generally given to the Exhibition, was over a mile and a quarter; at its northern end the grounds were about 600 yards wide, extending to nearly a mile at its southern; the total area of the park was about 580 acres, or less than a square mile. A small portion of the north end had been previously laid out as a park, but the greater part of the site was unreclaimed ground when the Exposition Company commenced their operations.

* A very full account of the history of the early stages of the Exhibition is given in the "Official Directory of the World's Columbian Exposition," Chicago, 1893. Arrangements have been made for the preparation of a full report on the Exposition by a Committee of the National Commission, but it is not known how soon the completion of this work may be expected.

A portion of the area was occupied by a large lagoon. It was decided to deepen this lagoon where necessary, and further to lay out a system of waterways and canals, utilising the material thus obtained for raising those parts of the ground on which the buildings were to be placed. This scheme was very successfully carried out, under the direction of Mr. Olmsted a well-known landscape gardener, and Mr. Burnham, who became first Chief of Construction, and afterwards Director of Works.

As may be seen from the map (Appendix 16), a very complete system of waterways was constructed, and this eventually proved of great service in affording means of transport from point to point of the Exhibition grounds.*

It was originally suggested that a portion of Washington-park, an area lying to the west, about two miles inland from the shore of the lake, should be utilised for the purposes of the Exhibition, and that the broad strip of land connecting the two parks, and known as the Midway-plaisance, should be taken in.

Eventually, it was found that there was no necessity to occupy any part of Washington-park; but the Midway-plaisance became a portion of the Exhibition grounds, and along it were situated the various shows and entertainments which formed, to many of the visitors, so attractive a part of the Exhibition generally.

The Midway-plaisance was a little more than a mile long and about 200 yards across. Its area was about 80 acres, so that with this addition the total area occupied by the whole of the Exhibition may be taken as just a square mile.

The grounds being so far distant from the centre of the city, it became necessary to provide special facilities for the conveyance of visitors. It was originally thought that a great number of visitors from a distance would come direct to the grounds, and for this purpose a large terminal station was constructed, into which excursion trains from all parts of the country might run. In practice, however, this enormous station, erected at a cost of \$200,000 (£40,000) was very little utilised; visitors either went into the city and

* The grounds and buildings have been described in great detail in various guide-books, periodicals, and newspapers. Reference may be made for such descriptions to the "Official Directory" above mentioned, the Handbook issued by the Royal Commission, and the "Memorial of the World's Columbian Exposition," published by the Committee on Ceremonies, 1893; a short list of other books is given in Appendix 33.

came down daily to the grounds, or resided in some of the many hotels which were erected in close proximity to Jackson-park.

The Illinois Central Railway passes close along one side of Jackson-park, and this formed the principal means of communication with the city. The accommodation of this road was increased for the purposes of the Fair, and a special service of express trains was organised, in addition to the usual suburban service, which was also largely extended.

This special service was admirably worked, and the enormous crowds were transported with a minimum of inconvenience and delay.

The elevated railroad, which has lately been constructed in Chicago, was extended and brought within the Fair-grounds; a considerable proportion of the visitors were carried by this route.

In addition to the railways, there was a series of cable cars running into the city and delivering their passengers at one or other of the entrances to the grounds, and also a service of steamers from the centre of the lake front of the city to one or other of the two piers which were constructed in the Exhibition grounds.

The size of the grounds themselves rendered special provision necessary for locomotion within them.

It was at one time proposed to have a "moving side-walk" laid down in the grounds, but this project was abandoned. This arrangement consists of a continuous travelling platform, running at such a speed that a person can easily step on to it while it is in motion. A second similar platform travels on the first, running at a correspondingly higher speed, and to this the passengers can step from the first platform. A short experimental length was laid down on the pier, and served to convey visitors from the landing stage to the shore end.

It was also proposed to construct a sliding railway (*Barre's chemin de fer glissant*) along the Midway-plaisance, but this, though commenced, was never completed.

An elevated railway, worked by electricity, ran round three sides of the park, terminating in a loop at each end, so that the trains were never reversed. This was largely patronised, but it had this drawback, that it did not convey passengers along the lake side of the park, and through the most frequented parts of the grounds.

The system of waterways rendered possible the organisation of a service of electric and steam launches, these were found very con-

venient as did also the gondolas, which plied from point to point of the lagoons. A number of rolling chairs were provided, in which visitors could be wheeled about. These were popular and largely used; still there were a good many complaints that the means of locomotion were insufficient, and the difficulties of getting about from one part to another of the park were considerable.

The position of the principal buildings is given in the map, which forms Appendix 16 to this report, and a list of them and their dimensions will be found in Appendix 17.

After the conclusion of the Exposition, Jackson-park was handed back, with the buildings in it, to the Park Commissioners, and a sum of \$200,000 (£40,000) was agreed to be paid to them by the Exposition Company in lieu of dilapidations.

VI.—DEDICATION CEREMONIES.

The buildings were handed over to the National Commission by the World's Columbian Exposition Company on the 21st of October, 1892. One object of this proceeding was that, the Exhibition itself having been deferred till 1893, at least its formal inauguration might fall within the quatercentenary year, 1892. The ceremonies connected with this dedication of the buildings for the purposes of the Exhibition extended over three days. The Royal Commission was represented by Mr. Alfred Carpmael* and Mr. J. Biddulph Martin, with Colonel G. E. Grover.

Not very long after his return to England (on February 1, 1893), Mr. Carpmael died, to the sincere sorrow of his colleagues on the Commission. His legal knowledge, always placed at their disposal, was constantly of very great value to the Commission.

VII.—OPENING OF THE EXPOSITION.

The formal opening of the Exposition took place on the 1st May. For the purposes of the ceremonies a large platform was erected in front of the East façade of the Administration Building, and this was occupied by about 1,500 guests to whom invitations had been issued. The President of the United States (Mr. Grover Cleveland) delivered an address, at the conclusion of which he declared the Exhibition open. He was attended by the principal Secretaries of State, and there were also present the diplomatic representatives of various foreign countries, the foreign Commissioners to the

* The report made by Mr. Carpmael on his return is published as Appendix 30.

Exhibition, and many other distinguished personages.

Sir Julian Pauncefoot, H.M. Minister (now H.M. Ambassador) at Washington, was unfortunately prevented by illness from carrying out his intention of being present. The British Commission was represented by Sir Edward Birkbeck, Bart., Mr. Walter Harris, Mr. James Dredge, Sir Henry Trueman Wood (Secretary), and Col. R. W. Edis, the honorary architect.

VIII.—EXECUTIVE STAFF.

As previously stated, the President of the National Commission was Mr. T. W. Palmer, but the Chief Executive Officer was the Director-General, Colonel George R. Davis. The constant kindness and unvarying courtesy of both these gentlemen deserve the fullest acknowledgment from the Commission. Colonel Davis was never too weary to attend to any application on behalf of the British Section, and never was any request made to him which did not receive prompt and kindly attention. It is difficult to overrate the value of his most friendly aid, and to express the appreciation of the cordiality of their mutual intercourse felt by the British Executive. Under Colonel Davis were the chiefs of the thirteen departments of the Exhibition, and of the special departments of "Publicity and Promotion," and "Foreign Affairs." The names of all these gentlemen, and of the other principal officials, are given in Appendix 7.

It was with the department of Foreign affairs that the representatives of the British Commission were particularly brought into contact, and the Commission gratefully acknowledge the courtesy and attention shown by the officials of that department.

With all the other chiefs the relations of the Commission and its executive staff were most harmonious. They were brought specially in contact with the superintendents of the various departments of the British Section, and from the beginning to the end of the Exposition they were at all times ready to do anything in their power to promote the interests of the section. The Commission are much indebted to them for their constant kindness and assistance.

Though the relations of the Commission with the officials of the Exposition Company were less direct, they were none the less cordial.

Mr. Higinbotham, the president, was always easy with advice or assistance whenever con-

sulted or appealed to; and the same may be said of the Vice-President, Mr. Ferdinand W. Peck, and, indeed, of the other members of the Directory.

That the relations between the executive of the British Section and the authorities of the Exhibition should throughout have been of so cordial a character is a source of gratification to the Commission. Looking to the close ties which bind the two countries this result might have been anticipated, but it is satisfactory to be able to report that in an enterprise of such magnitude, involving many complicated and, in some cases, conflicting interests, no misunderstandings should have arisen, but that the friendly feelings with which the mutual intercourse commenced should have been deepened and strengthened throughout its continuance and till its completion.

IX.—NUMBER OF ADMISSIONS.

The total number of paid admissions was 21,477,212, an enormous number, only surpassed by Paris in 1889, with its total of 25,398,600. At Chicago, however, the full admission fee of half-a-dollar was charged (children being admitted at half-price), whereas at Paris the tickets nominally priced at a franc were sold at various cheap rates, varying from 80 to 25 centimes.

The great attendances were in the last three months, and especially in the last month of all, October. The greatest crowd which has ever been known to have assembled together, certainly the greatest crowd of which an accurate record has been kept, was that which visited the Exhibition on October 9, "Chicago Day," and numbered about 765,000 (there were 716,881 paid admissions, and about 5,000 free). The first really large attendance was naturally on July 4, when there were 283,273. With this exception, "British Day" (August 18), with 168,861, was the largest up to that date, but this record was soon broken by "Illinois Day" (August 24), with 243,951. In September the daily average increased to 190,000, and in October to 250,000.

The charge for admission was uniformly half-a-dollar (two shillings English), and the system adopted was a ticket one. Tickets were on sale at various offices in the city and near the entrances. There were no season tickets.

The higher officials were admitted by means of "complimentary" tickets, and there were also

a certain number of badges issued to heads of departments, and the chief officials of foreign Commissions, which carried with them the privilege of admission. Bearers of these complimentary cards or badges were required to deposit with the gatekeeper on entering a visiting-card, or a slip of paper with their name on it.

The members of the Exhibition staff, and of the staffs of foreign Commissions, as well as exhibitors, were furnished with photographic passes. These consisted of books of coupons, one for each day of the six months during which the Exhibition was open. One of these coupons was detached by the gatekeeper. If the bearer desired to leave the grounds and re-enter them, he presented his book and was given a ticket of re-entry. The book contained on the inside of the cover a photograph of the owner, for taking which a fee of a dollar was charged. Workmen and temporary *employés* were furnished with a card to be exhibited at the door.

X.—THE COST OF THE EXHIBITION.

In ascertaining the total cost of the World's Columbian Exposition, there have to be considered the grants made to, and administered by, the National Commission and the Board of Lady Managers, as well as the revenues raised and expended by the Exposition Company. There is also to be reckoned the grant of \$1,500,000 (£300,000) made by the United States Government for the exhibit of the departments of State.

The accounts of the Exposition Company have been published in full detail. Their sources of revenue were, a grant from the city of Chicago, the subscriptions to the company, a grant from the United States Government, and the receipts from admissions, concessions, &c.

It will be remembered that a sum of \$10,000,000 (£2,000,000) had to be provided before the Exhibition was assigned to Chicago. The amount actually paid up was in excess of this, reaching \$10,600,000 (£2,100,000). Of this the city gave \$5,000,000 (£1,000,000), while the amount subscribed by the stockholders was \$5,600,000 (£1,100,000). In the spring of 1893 an application was made to Congress to grant or lend a sum in aid of the Exhibition, \$5,000,000 (£1,000,000) being suggested. A grant of \$2,500,000 (£500,000) was made, and it was decided that the money should be paid in a special coinage, known as souvenir half-dollars. It was estimated that the coins could be

sold at a dollar apiece, so that the grant would be really equivalent to \$5,000,000. At a later date, the United States Treasury kept back out of this grant a sum of \$570,880 (£114,000), the amount required for the expenses connected with the awards, so this portion of the grant has really to be credited to the National Commission, not to the company. The amount realised by the company was under two millions and a half, \$2,446,642 (£409,000).

The receipts from admissions were \$10,600,213 (£2,120,000); from concessions, \$3,742,688 (£750,000); miscellaneous receipts and interest produced \$796,107 (£159,000). The total receipts were \$28,191,624 (£5,640,000). The expenses were summarised under the heads of—Construction, \$18,458,692 (£3,691,700); preliminary organisation, \$90,674 (£18,000); and general expenses, \$7,238,734 (£1,447,000). The total expenditure up to the closing of the Exposition was given as \$26,110,330 (£5,222,000).*

It will, therefore, be seen that, treating the subscriptions to the company, and the grants from the city and the State as gifts, not as loans, the Exhibition was a considerable financial success. There was, at the close, actually a balance of \$2,000,000 (£400,000), a large proportion of which was available for the subscribers, who certainly never expected to receive any of their money back.

No account appears as yet to have been published of the expenditure of the National Commission and of the Board of Lady Managers. It is stated that the Federal Government appropriated in all \$5,371,625 (£1,074,325) for the purposes of the Exhibition up to the end of June.

The total outlay by the American Executive upon the Chicago Exhibition may be taken as about six millions sterling, of which it may be said, roughly, that three millions were earned by the Fair, two millions subscribed by Chicago, and a million provided by the U.S. Government. Besides the above sums there were, of course, the sums granted by the various participating foreign Governments.† The total of these is estimated at about \$7,000,000 (£1,440,000).‡

* These figures were taken from the report of the auditor, issued 12th December, 1893. They will, doubtless, show some small differences with the final account when it comes to be published.

† A list of these will be found in Appendix 13.

‡ The receipts from the London Exhibition of 1851 were £506,243 (including £67,896 subscriptions), the number of visitors 6,039,195. From 1862 the receipts were £459,631, the

XI.—SPACE IN THE BUILDINGS.

The total area within the Exhibition buildings allotted to the United Kingdom and British possessions was just 500,000 square feet (500,074), of which over 300,000 (306,285) was assigned to Great Britain. This is very much the largest area ever occupied by this country at any International Exhibition.*

The manner in which the space was distributed among the various buildings of the Exhibition is shown in the following Table:—

	Square Feet.
Agriculture	13,776
† Horticulture	none
Fisheries	650
Mines and Mining	8,000
Machinery	40,000
Transportation (including Annexe and Gallery)	54,257
Manufactures	100,400
Liberal Arts (Gallery of Manufactures Building)	59,560
Electricity	5,400
Woman's Building	2,384
† Forestry	none
Fine Arts	21,400
Total	306,285

visitors numbered 6,211,103. At Paris in 1855, 5,162,300 visitors only paid £128,099; in 1867 there were 6,211,103 visitors, the receipts amounting to £408,530; the receipts in 1878 do not seem to have been published, there were 16,159,719 visitors; in 1889 there were 25,398,609 paying visitors, the receipts (from all sources including subsidies) were given as £1,980,000, the expenditure at £1,660,000. In the case of the Paris Exhibitions there were large grants from the Government and the City of Paris, so that the actual receipts only covered a portion of the outlay. At Vienna in 1873 there were 6,740,500 visitors, and the receipts were £206,477. At Philadelphia there were 8,140,193 visitors, the receipts from admissions alone were £798,675. At the four South Kensington Exhibitions (1883-86) the results were—Fisheries (1883), receipts £162,903 (including £8,702 subscriptions), visitors 2,703,051; Health (1884), receipts £237,048, visitors 4,153,390; Inventions (1885), receipts £208,490, visitors 3,760,581; Colonies and India (1886), receipts £249,861 (exclusive of Colonial and Indian contributions), visitors 5,559,745. At the Military and Naval Exhibitions held at Chelsea in 1890 and 1891, the results were—Military (1890), receipts, £55,056, visitors, 923,761; Naval (1891), receipts, £155,447, visitors, 2,351,683.

* The amount of space occupied by Great Britain and the Colonies (including India) at Paris, in 1867, was 280,604 square feet, the expenditure was £126,000. At Vienna, 1873, the space was 169,827 square feet, the cost £28,753. At Philadelphia, 1876, the space was 194,381 square feet, the cost £39,981. At Paris, 1878, the space was 363,018 square feet, the cost £66,983. At Paris, 1889, the space was 232,845 square feet, the cost £29,422.

† The space in the Horticultural Building was eventually surrendered to the Executive in consequence of the withdrawal of the exhibitors to whom it had been allotted.

‡ The whole of the space assigned to Great Britain in the Forestry Building was made over to India.

The 198,516 square feet assigned to the Colonies and India was divided, approximately, as follows:—

	Square Feet.
Canada	100,140
New South Wales	50,951
Cape Colony	5,250
Ceylon	27,574
British Guiana	3,367
Jamaica	4,250
Trinidad	3,400
India	3,584
Total	198,516

Besides this amount, spaces were assigned in the grounds of Jackson-park for the Victoria-house (7,560 square feet), the buildings of Canada and New South Wales,* the Indian Pavilion (4,800 square feet), erected by the Indian Tea Association, the Kiosk of the White Star Steamship Company, and the structure set up by the Maxim-Nordenfellt Company for demonstrations of their quick-firing gun.

XII.—ALLOTMENT OF SPACE.

The difficulties of the task of apportioning the space equitably among the numerous claimants was increased by the fact that space was assigned to Great Britain in eleven different buildings (including the Women's Building and the Fine Arts Building). In some of these the amount allotted was insufficient for, in others it was in excess of, the requirements. Thus, in the Horticultural Building, no special space was required; in the Fisheries, very little; in the Electrical Building; and in Agriculture, less than was offered. On the other hand, the original allotments in the Manufactures Building were quite insufficient, and that in Transportation hardly enough. This was partly remedied by the grant of that portion of the gallery of the Manufactures Building, adjacent to our space on the ground area, and the enlargement of the original Transportation assignment; while the Commission were able to render useful aid to the Commissions for Canada and New South Wales, by surrendering to them considerable space in the Agricultural and Mining Buildings.

As has always been the case in Exhibitions, when no charge has been made for space, further difficulties were made, by the withdrawal of many intending exhibitors. In most

* The area of the Ceylon building (5,000 square feet), is included in the above list, because it was devoted to exhibits

cases, however, the places of those who withdrew were taken by late applicants. In the Machinery Building, however, some vacant spaces were left which could never satisfactorily be filled, and which, from their position, could not well be transferred to any other Commission. Constant changes were thus rendered necessary, even after the opening of the Exhibition. Applications were received and attended to up to the latest possible date, and as long as any space remained available.

The allotment of space commenced in May, 1892, though, even before this date, a few exhibitors, who had special arrangements to make, had positions assigned to them. The issue of the allotments was practically completed by November of that year. In the case of the Fisheries Department, the grant of space was not received from the American Executive until March, 1893, and, consequently, the issue of allotments to the few exhibitors in this department was delayed, with the unfortunate result that some of them were unable, at such short notice, to complete their arrangements, and, consequently, withdrew.

XIII.—NUMBER OF BRITISH EXHIBITORS.

The total number of exhibitors was 2,236, of whom 597 were Industrial, 501 Fine Art, and 1,138 Women's Work.* In this total are also included the 18 Indian exhibitors who came under the British Section. The following list shows their classification in the different departments:—

Department A, Agriculture and Food	59
„ B, Horticulture	20
„ C, Live Stock	—
„ D, Fish and Fisheries	8
„ E, Mines and Mining	38
„ F, Machinery	34
„ G, Transportation	72
„ H, Manufactures	179
„ J, Electricity	8
„ K, Fine Arts	501
„ L, Liberal Arts	152
„ M, Ethnology (Women's Work). 1,138	
Indian Exhibits	18
	2,236

As in the case of many previous Exhibitions, this number does not appear to compare favourably with the number of exhibitors in many foreign countries, but this is to a large extent due to the fact that in other countries than Great Britain, there are frequently

* In Paris, 1889, the British exhibitors were classified as:—Industrial, 673; Fine Arts, 297; Social Economy, 47; total 1,017. At Philadelphia, 1876, they were:—Industrial, 624; Fine Arts, 223; Live Stock, 16; total, 863.

large collective exhibits, the individual contributors to which all appear in the General Catalogue, although their exhibits, in many cases, may occupy only a very small area. It may be noted that the largest number of the British exhibitors appears to be that of the Women's Section, though the area occupied in that section was comparatively small. In the Manufactures Building 179 exhibitors filled 100,400 square feet, while in the Women's Building 1,138 exhibitors found sufficient space in 2,384 square feet. It is also to be remembered that considerable discrimination was exercised in accepting applications. It is, however, greatly to be regretted that the total number of exhibitors was not larger, and that many important branches of manufacture were so sparsely represented.

XIV.—ATTENDANCE OF MEMBERS OF THE ROYAL COMMISSION IN CHICAGO.

The following members of the Royal Commission visited Chicago during the Exhibition:—Sir Richard E. Webster, G.C.M.G., Q.C., M.P. (Chairman), Sir Edward Birkbeck, Bart. (Vice-President), Michael Carteighe (Vice-President), John Biddulph Martin (Vice-President), W. H. Preece, C.B., F.R.S. (Vice-President), George Ledgard Bristow, James Dredge, Francis Elgar, LL.D., Professor Clement Le Neve Foster, D.Sc., F.R.S., Walter H. Harris, John Fletcher Moulton, M.A., Q.C., F.R.S., John O'Connor, and Florence O'Driscoll, M.P.

XV.—VICTORIA-HOUSE.

At the request of the Royal Commission, the Chicago executive granted a site for a special British building. The position of this site is shown in the map which forms Appendix 16. It certainly was as fine a situation as could be found in Jackson-park. It occupied a most conspicuous position on the shore of the lake, and was the only building on the lake-shore in the northern portion of the grounds. It was separated from the rest of the park by a wide roadway, which extended the entire length of the park by the side of the lake.

The plot of ground assigned to the Commission occupied an area of about three-quarters of an acre, or 3,000 square yards. It was triangular in form, so that only a portion of it could be conveniently occupied by the building, the remainder having to be laid out as garden ground. The building itself had a frontage of 90 feet and was 64 feet deep.

The Commission invited Colonel Robert W. Edis to act as its honorary architect, and, on his accepting, they requested him to prepare plans for a characteristic British House. The idea of reproducing some well-known English house was, after full consideration, abandoned, as it was soon evident that it would be difficult to find one that would not be too large and too costly to reproduce. Colonel Edis was, therefore, instructed to design a suitable building which might serve as offices of the Commission, and also for the reception of British and colonial visitors to the Exhibition. This task he carried out in a thoroughly satisfactory manner.

The building was generally characteristic of the best type of English half-timber houses of the 16th century, of which there are so many good examples still extant. It was, however, a modern house, and for this reason it was considered permissible to employ terra-cotta somewhat largely in the lower storey, with red brick facing and mullioned windows. The upper portion was of half-timber construction, with overhanging and projecting gables.

The plan formed three sides of a quadrangle, with the open side next the lake, enclosed by a raised terrace with balustrade. The centre, on the front or inland side, was recessed, with steps leading from both sides up the covered portico, which opened into a large central hall; off this were, on one side, large library and reception-rooms, while the other wing was occupied by the offices. On the first floor was a large suite of rooms and offices. Great care was bestowed on the interior decorations. All the principal rooms were fitted with wall panelling and elaborate ceilings, after the manner of some of the best English country houses.

The interior woodwork and fittings and all the furniture were contributed as an exhibit by Messrs. Johnstone, Norman and Co. The entrance hall, staircase, and reception-rooms were very completely decorated and fitted by this firm, from the designs and under the superintendence and advice of the honorary architect.

The furniture was all specially designed for the house with the exception of a few pieces, which were reproductions of old and well known examples.

The house was wired throughout for the electric light. The original plans provided for a maximum of 166 incandescent lamps, of 16 candle-power. The charge, however, made by the Exposition for the supply of current—\$8

(£112s.) per lamp—was considered prohibitive, since the light could only be used occasionally. Eventually, an arrangement was made, for the later months of the Exhibition, under which the payment corresponded to the amount of light actually required; and, from the 19th August, the use of 40 lights, in any part of the building, was secured for \$127 (£25 10s.).

The handsome wrought-iron electric fittings of the public part of the house were supplied, as an exhibit, by Messrs. Starkie Gardner, and Co. Those for the offices were purchased in Chicago.

Messrs. Doulton and Co. lent a very handsome Doulton-ware fountain, which was erected in the courtyard of the house, and the same firm exhibited a replica, in terra-cotta, of Bell's fine group of America, the original of which is at the base of the Albert Memorial in Kensington-gardens. This was placed in a commanding position at the intersection of two roadways in front of the house. The group, at the close of the Exhibition, was most generously presented by Sir Henry Doulton to the City of Chicago.

In carrying out the decoration and furnishing of the house, the following firms rendered great assistance, by supplying, or specially executing, decorative work, of their respective manufactures, viz.:—Messrs. Jeffrey and Co., London, the embossed leather on walls of staircase and waiting room, and the whole of the papers used throughout the building; Messrs. Yates and Co., Wilton, near Salisbury, hand-made real Axminster carpets in the principal rooms; Messrs. Starkie Gardner, and Co., London, wrought iron locks and hinges, for woodwork in principal rooms, as well as the electric light fittings mentioned above; Messrs. Feetham and Co., London, the dog stoves and fireplace fittings in entrance hall and reception-room; Messrs. Campbell, Smith and Co., three painted glass windows.

The internal decorations of the house were greatly admired. The Commission feel that they are greatly indebted to the honorary architect for the time and skill which he devoted to their service, and also to Messrs. Johnston and Norman for their enterprise. Some descriptive details are given in Appendix 14, and a view of the building in Appendix 15.

Before the house was built, the designs were submitted to Her Majesty, who was graciously pleased to accept a pen and ink drawing of the new building, and to command that it should bear her name. The building was, in consequence, known as Victoria-house,

a title which added greatly to its interest in the eyes not only of English and colonial visitors, but also of Americans.

To carry out the difficult duty of arranging for the construction of the building and superintending it in progress, the Commission was fortunate in securing the services of Colonel Grover, R.E. This officer whose distinguished services rendered him a most desirable representative of the Commission, while his experience of former exhibitions specially qualified him for his duties, was appointed in April, 1892. On behalf of the Commission, he concluded an arrangement with the George Fuller Co., a well-known firm of Chicago contractors, for the construction of the building. On May 25th, 1892, the first pile of the foundations was driven, and by the autumn of the same year the exterior construction was complete. From January, 1893, it served for the offices of the Commission, but the whole of the interior fittings were not fully completed till the early part of June. Colonel Grover died suddenly in January, 1893, to the sincere regret of the Commission and of all with whom he was associated in Chicago.

The Commission desire to express their cordial appreciation of the assistance rendered them in the construction of the house by Mr. D. H. Burnham, the Director of Works, who, though he was overwhelmed with other work, gave special attention to the matter, and was ever ready with advice and information.

Special buildings were also erected by Germany, France, Spain, Sweden, Brazil, and other foreign countries, and by Canada, New South Wales, and Ceylon among the British Colonies.

Victoria-house was not originally designed with a view to the admission of the general public, as it was thought that the precedent set at Philadelphia in 1876 might be conveniently followed, and that all reasonable requirements would be met by providing a liberal supply of tickets, so that any visitor having special interest in the matter might have an opportunity of inspecting the house.

The furniture was of a very costly nature, and the arrangements, generally, were not such as could permit it to be inspected by a large number of persons, the rooms being fitted, not for exhibition purposes, but for ordinary use. At an early period of the Exhibition, however, a great desire was shown by visitors for free admission to the rooms, without the necessity of obtaining tickets, and some complaints were made as to the non-

admission of the public. Accordingly, the house was thrown open in the afternoons from 2 to 5, the mornings being reserved for those who desired to make a more detailed inspection of the rooms and furniture.

This arrangement was rendered necessary by the conditions under which Messrs. Johnstone, Norman, and Co. had agreed to supply the furniture, that they should have full opportunity of showing it to possible purchasers, who would not, of course, have sufficient opportunity of seeing it when the house was filled with visitors.

It is believed that the arrangement gave satisfaction; and certainly the opportunity of inspecting the house was taken by large crowds. During the earlier months of the Exhibition, the numbers averaged 3,000 a day, and, at a later period, they reached 5,000 and 6,000. This admission of the public to some extent interfered with the convenient use of the house for its intended purposes; and the idea of making it a rendezvous for English and Colonial visitors had, in consequence, to be abandoned. It, however, served for various receptions, to which the officials of the Exhibition, foreign Commissioners, and others were invited; and, notably for one, on the day of the Duke of York's wedding, when an enthusiastic meeting of the British exhibitors was held, for the purpose of despatching a congratulatory message to their Royal Highnesses.

Several exhibiting firms were good enough to supply articles for use in Victoria-house. Barlow and Jones supplied towelling; Brown and Sons, table linen; Chubb and Sons, two safes; Daniell and Sons, china and glass; the Goldsmiths' and Silversmiths' Company, plate and cutlery; Messer and Thorpe, fire extinguishing apparatus; Tooth and Sons, engravings; and Treloar and Sons, mats; Sutton and Sons also supplied seeds, which were raised by Mr. Thorpe, the chief of Floriculture, and the plants set out in the grounds surrounding the building. It is also fitting that the Commission should acknowledge the continual kindness of Mr. Thorpe, who constantly supplied shrubs and flowers for the decoration of the house.

A great many proprietors of London newspapers very kindly sent copies of their papers to the library of Victoria-house during the whole period of the Exhibition. These were regularly filed, and were much appreciated by visitors, especially English visitors.

The Commission desire to place on record their view that on the occasion of any future

Exhibition the question whether any building of the kind should be of a permanent character will require careful consideration. The Exhibition at Chicago developed new features in connection with such gatherings, and the various State buildings and buildings erected by foreign countries, became centres of attraction and rendezvous for the citizens and subjects of the States, and nations which they represented. In view of this development, the considerations, which must vary considerably in the case of each Exhibition, to be borne in mind are, whether a temporary building should be erected affording large accommodation for visitors, the rooms being kept comparatively free from exhibits, or whether, as in the case of Victoria-house, the building and its contents should be treated as a special exhibit. It is obvious that if the latter course be adopted accommodation for visitors cannot be supplied to the same extent or with the same freedom. All views of the question require great consideration. In the case of Chicago the Commission incline to the opinion that it might have been better if a less expensive building had been erected, the elaborate internal fittings dispensed with, and the valuable exhibit of furniture by Messrs. Johnstone and Norman displayed elsewhere; but this view and the necessity of a different adaptation of the building could not be foreseen in the light of previous experience, the characteristic features of the World's Columbian Exposition developing themselves for the first time in the history of exhibitions.

XVI.—EARLY MAP OF AMERICA.

In response to a request from the United States Government, conveyed through their Minister, Mr. Robert Lincoln, Her Majesty the Queen was graciously pleased to lend, from the library of Windsor Castle, a map, by Leonardo da Vinci, interesting as being the first on which the name "America" appears. This map was placed in the reproduction of the Convent of La Rabida, in which building were bestowed the historical relics relating to the discovery and settlement of America.

XVII.—COLONIES.

In no previous Exhibition have the British Colonies taken so important a position as they did at Chicago, or occupied so large a space though at Paris (1867) and Philadelphia (1876) a greater number of Colonies were certainly represented. The area filled at Chicago by the Colonies (193,666 square

feet) was practically equivalent to that occupied by the whole British Section at Philadelphia (194,381 square feet). They supplemented in the most valuable manner the contributions from the Mother Country, and since the Colonial exhibits were to a very large extent raw products, the class in which there were fewest contributions from Great Britain, it happened that the classes in which the Colonies were strongest were generally those in which the Mother Country was weakest. Treating the exhibits of the British Empire, her Colonies, and Indian dependencies as a whole, it may be fairly stated that the collective exhibit was superior to that of any other country. The total of the grants made by the Colonial Governments to their Commissions were certainly more than double the amount at the disposal of the British Commission. Their precise amount cannot at present be ascertained.

The Colonies exhibiting were Canada, New South Wales, the Cape, Jamaica, Ceylon, British Guiana, and Trinidad. It had been expected that other British Colonies would also be represented. Of the Australian Colonies, Victoria, Queensland, and Tasmania had under consideration the question of appointing Commissions, but eventually they abandoned the idea of exhibiting. A few exhibits, however, from Victoria, New Zealand, and Queensland found space in the British Section, and an exhibit of New Zealand wool was placed among the United States exhibits. The Governments of Bermuda and of Mauritius applied for space, but afterwards retired; some of the West Indian Islands also, and British Honduras, were expected to exhibit, but eventually they also took no part in the Exhibition. In all cases the Colonial Governments appointed separate and independent Commissions,* who dealt directly with the American Executive. At the same time, the most harmonious and friendly relations existed between them and the British Executive, and on various occasions the representatives of the Commission in Chicago were able to afford assistance in the matter of space allotments, awards, and other matters, to the Colonial Commissioners.

For details concerning the exhibits of the various Colonies, reference should be made to the reports of their respective Commissions, which will, in due course, be presented to their Governments. In this report it is only

* See Appendix 6 for list of names.

proposed to include a few facts and statistics which have been obligingly furnished by the various Commissioners.

Canada.—The Dominion of Canada appointed as their Executive Commissioner Mr. William Saunders, but Mr. Saunders was compelled, by ill-health, to retire in November, 1892, and his place was taken by Mr. J. S. Larke. Mr. G. R. R. Cockburn, M.P., and the Hon. Joseph Tassé were also appointed Honorary Commissioners to represent the Dominion at Chicago. Canada occupied space in all the buildings, and filled a total area of 100,140 square feet. Their largest space was in the Manufactures Building (25,190 square feet, of which 8,998 was in the Liberal Arts Gallery); but their exhibit in the Agricultural Building (16,860 square feet) was also a very large and important one. They also showed in the Transportation (16,667 square feet), Mines (9,602 square feet), Horticulture (8,500 square feet), Machinery (8,140 square feet), Fisheries (6,940 square feet), Forestry (3,071 square feet), Anthropological (1,200 square feet), Dairy (575 square feet), Electricity (500 square feet), and occupied a gallery (2,895 square feet) adjacent to the British Section in the Fine Art Building. In the Dairy and Live Stock exhibits Canada took a very important position, carrying off a very high per-centage of the prizes offered. The Canadian Building was situated just opposite Victoria-house, on a plot of land assigned for the purpose by the American Executive. In it were the offices of the Executive Commission, and of the Special Commissioners who had been appointed by many of the provinces of the Dominion.

New South Wales.—The Executive Commissioner for New South Wales was the Hon. Dr. Arthur Renwick, M.L.C., who, under the direction of the Royal Commission for that colony, assisted in the formation of the collection in Australia, superintended its arrangement at Chicago, and remained in charge during the whole of the Exhibition. New South Wales exhibited in the following buildings:—Agriculture (8,963 square feet), Forestry (3,098 square feet), Machinery (1,425 square feet), Transportation (1,773 square feet), Fine Arts (3,870 square feet), Fisheries (1,656 square feet), Liberal Arts (6,247 square feet), Manufactures (5,090 square feet), Mines (8,300 square feet), Ethnology (4,666 square feet), Horticulture (5,749 square feet), Women's (384 square feet). The total area occupied was 50,951 square feet.

The most important exhibits of the colony were in the Agricultural and Mines Building, the display in the latter being certainly equal to that made by any State of the Union; the wool and grain exhibits in the Agricultural Building were also of the very highest class. The extensive character of the exhibits from New South Wales may be understood from the fact that no less than 800 awards were granted to the colony. The exhibits were forwarded, for the most part, from Sydney *via* San Francisco to Chicago, but a small proportion came by way of London, and some by Vancouver. Altogether there were fourteen shipments, and the tonnage was nearly 900 tons, the number of packages being over 4,000; in addition, there were also 8,000 wooden blocks, similar to those used for paving the streets of the great cities in Australia. The New South Wales Commission erected a special pavilion for its offices on a site nearly adjoining that occupied by Victoria-house.

Cape Colony.—Mr. L. Wiener, M.L.A., was the Commissioner for the Cape, which exhibited in the Agricultural Building (2,100 square feet), Mining Building (2,500 square feet), Transportation Building (500 square feet), Women's Building (150 square feet); a total area of 5,650 square feet. There was a very fine display of diamond-washing machinery and diamonds in the Mining Building, and in the Agricultural Building were some fine specimens of wool, and an attractive exhibit of ostrich feathers. The colony was also, in other respects, strongly represented.

Ceylon.—The Hon. J. J. Grinlinton, M.L.C., was the Commissioner for Ceylon. Mr. Grinlinton visited Chicago in the summer of 1892, and was thus able to make specially favourable arrangements for the representation of Ceylon. The most important exhibits of this colony were contained in the special pavilion which was erected on a site facing the lake in the northern portion of Jackson-park, not far from Victoria-house. Its area was 24,000 square feet. The colony also had space in the Manufactures Building (1,350 square feet), Agricultural Building (1,684 square feet), and Women's Building (540 square feet); the total area occupied was 27,574 square feet.* One special object in Mr. Grinlinton's appointment was to promote the sale of Ceylon teas in

* This includes the Ceylon Pavilion (5,090 square feet), which was really exhibiting space. In the other Colonial buildings there were no exhibits.

America, and this he did most effectively by the sale of the tea, both dry and infused, in the Ceylon Pavilion, and in the other pavilions which he set up on the various spaces allotted to the colony, the tea being served by Cingalese attendants, whom Mr. Grinlinton had brought over from Ceylon for the purpose. He was so successful in his efforts, that he was able, before leaving Chicago, to establish a permanent office in the city for the supply of tea from Ceylon.

British Guiana.—Mr. J. J. Quelch was the Commissioner for British Guiana. This colony exhibited in the Agricultural Building (1,887 square feet), Ethnological Building (1,280 square feet), and Transportation Building (200 square feet); total, 3,367 square feet. The exhibits included sugars and other products, minerals, a fine collection of specimens of woods, and a collection illustrating the natural history of British Guiana. Some natives of the colony were also brought over by Mr. Quelch, and were on duty as attendants in the courts.

Jamaica.—The Commissioner for Jamaica was the Hon. Col. Charles J. Ward, C.M.G. The only exhibit of this colony was in the Manufactures Building, the amount of space occupied being 4,250 square feet. Here were shown specimens of the principal products of the island—raw and manufactured coffee, sugar, starches, tobacco, fibres, rum, leather, fruits, pottery, woods, &c. Some plants from Jamaica were also shown in the Horticultural Building.

Trinidad.—Mr. Harry Vincent was the Executive Commissioner for Trinidad. This colony occupied spaces in the Agricultural Building (1,400 square feet), Horticultural Building (1,400 square feet), and Forestry Building (600 square feet); total, 3,400 square feet. The exhibits included sugar, cocoa, fibres, fruits, pitch, and a choice collection of specimens of timber.

XVIII.—INDIA.

A Special Committee was appointed for India, of which Sir Owen Burne, K.C.S.I., was chairman, and Mr. S. Digby, hon. secretary. On the advice of this committee, the Commission made several appeals to the India-office, and to the Government of India, through the India-office, but without much effect. Failing official aid, it endeavoured to enlist the support of the various Indian Chambers of Commerce, and other public bodies, with little better result.

The Government of India did not at first

propose to take any part in the Exhibition, but eventually they made a grant of 40,000 rupees to the Indian Tea Association, to assist them in exhibiting Indian Teas, and a grant of 10,000 rupees to Messrs. Tellery, of Delhi, to aid in the formation of a representative collection of Indian Art Ware. Mr. R. Blechynden was appointed by the Tea Association to take charge of their interests, and that gentleman, in conjunction with Mr. Tellery, arranged for the erection of a characteristic Indian building on a site near Victoria-house. In this pavilion, which was unfortunately not spacious enough to do justice to its admirable contents, the collection of art ware was displayed and the samples of tea exhibited. Messrs. Tellery's collection was valued at £26,000, and the expenses attendant on its exhibition are stated at £11,000. Permission was obtained for the sale and gratuitous distribution of the tea, which was served in the same building by native Indian attendants to large crowds of visitors daily. This liberality was greatly appreciated, and the popularity thus obtained for Indian tea can hardly fail to have a very considerable effect on its consumption in America and to increase the future trade in it. The Indian Government also prepared and sent a small collection of Indian Forest Products, which was shown in the Forestry Building, occupying a space of 1,000 square feet. There were, moreover, eighteen independent Indian exhibitors, who occupied a space of 2,584 square feet in the Manufactures Building. Application had been made by these direct to the Royal Commission, and they were dealt with on the same basis as the exhibitors from Great Britain.

XIX.—FINE ARTS.

The collection of works of art for the Fine Art Section was left entirely in the hands of a committee, of which Sir Frederic Leighton was the chairman.* The method of proceeding adopted by the committee was to prepare a list of artists whom it was thought desirable should be invited to contribute, and to ask each of these to name the pictures by which he would prefer to be represented. Application was then made to the owners of the pictures designated, asking for their loan. In many cases the request of the committee was not acceded to, but, on the whole, the owners proved liberal, and a satisfactory response was obtained.

* A list of this committee will be found in Appendix 3.

Her Majesty the Queen was graciously pleased to lend the following works:—"The Roll Call," by Lady Butler; "Jubilee Procession passing Trafalgar-square," by John Charlton; and "Return from Ploughing," by George Mason, A.R.A.; the Prince of Wales lent two water-colour drawings by Sir Oswald Brierly; the Duke of Edinburgh, a water-colour of "H.M.S. *Black Prince*," by the same artist; and H.R.H. the Duchess of Albany contributed the picture, "Weary," by Edward Radford.

A list of the owners who contributed pictures will be found in Appendix 20. To these gentlemen the cordial thanks of the Commission are due, for it is no small inconvenience to the proprietor of a picture to be deprived of it for the period of a year. Thanks to the liberality of the lenders, a very fine collection was brought together—a collection which, without much doubt, was the best which has ever been sent to any International Exhibition.

The Council of the Imperial Institute very kindly allowed the Commission the use of one of their galleries for the collection and packing of the pictures, and here also were sent the pictures which were submitted by artists who had not been specially invited. The same favour was granted on the return of the pictures, a gallery being lent at the Institute for the unpacking and distribution of the pictures.

The total value of the pictures exhibited by Great Britain was, as nearly as can be estimated, a little over £300,000. The value insured by the Commission was £200,000. As provision had been made at the earliest possible date to cover the greater part of this value, the Commission were fortunate in obtaining it at a low rate, but when, at a later stage of their work, it was found necessary to increase the amount insured, rates in some cases running up to six guineas per cent. had to be paid.

The pictures were despatched to Chicago during the month of March, 1893. The galleries were hardly ready for their reception when they arrived, but thanks to the energy of Mr. J. W. Beck, the Superintendent of the Fine Art Section, the pictures, with the exception of the architectural drawings and designs, which were in an upper gallery, were all hung and the galleries opened on the 1st of May. Though the galleries were thus opened to the public they were for a long time almost inaccessible in consequence of the building operations which were going on in the central hall of the Fine

Art Building. The building itself was 500 feet long and 320 feet wide. There were also two annexes, each 200 feet by 120. The area allotted to Great Britain was 20,325 square feet, and occupied one of the four divisions into which the main Fine Art Building was divided. There were seven galleries, the largest was 120 feet long by 30 feet wide; five others were 60 feet by 30 feet, and one was 44 feet square; all these galleries were fully occupied. Space was also provided for the drawings in black and white, the architectural drawings and designs, and the etchings and engravings, in the gallery of the upper floor which surrounded the main central hall of the building. The sculpture was arranged in a portion of the nave near the picture galleries, which was assigned for the purpose.

The Fine Art collection was greatly appreciated by visitors from all countries, and its high merit admitted by critics, both American and foreign. The galleries were crowded with visitors all through the time of the Exhibition, especially during the months of September and October, and it was most satisfactory to notice the interest and even enthusiasm with which the collection was received by a large proportion of the immense throngs of people of every class.

The number of awards made by the Fine Art Jury to the British Section far exceeded the number given to any other country in proportion to the number of works exhibited, not excluding the United States.

XX.—MANUFACTURES AND LIBERAL ARTS.

The building in which were contained exhibits in Department H, Manufactures, and L, Liberal Arts, was the largest in the park. It was 1,687 feet long by 787 feet wide. The area of the building was nearly 32 acres, and the gallery space was about 12 acres more.

The original allotment in the building was, for Great Britain and the Colonies—exclusive of Canada—120,000 square feet. By arrangement with the Executive, this total was increased to nearly 143,000 square feet, of which 100,400 square feet was reserved for Great Britain, the remainder being assigned to Canada, New South Wales, Ceylon, Jamaica, and India.

It will thus be seen that about one-eighth part of the building was filled by Great Britain and her Colonies.

The space occupied by Great Britain lay

south-west of the central point of the building. It was one of the four sections surrounding the central clock tower, the others being occupied by Germany, France, and the United States. In this, as in all the other buildings, the best possible position was assigned to Great Britain.

The first allotment did not include the gallery of the building above the British space, but eventually this gallery was assigned to the Commission for the Liberal Arts exhibits, Canada and New South Wales having adjacent allotments. It was also found possible to give up to these two Colonies a certain amount of the British space, and ultimately the area in the gallery reserved for Great Britain amounted to 64,200 square feet.

The two departments of Manufactures and Liberal Arts were placed in the charge of Mr. E. H. Fishbourne, and Mr. J. Bowdidge was appointed his assistant. The space here occupied was the largest filled by Great Britain in any of the buildings, and the exhibitors were much more numerous than in any other department. The actual numbers of exhibitors were—in Department H, Manufactures, 179; in Department L, Liberal Arts, 152, including certain loan exhibits. In Department H were included manufactures of all sorts; textiles; chemical and pharmaceutical products; furniture, pottery, glass, leather; lighting, heating, and cooking apparatus; and a large number of miscellaneous manufactures which could not properly be included in the other departments of the Exhibition. In allotting space to the exhibitors, the classification was closely followed, but there were a few exhibits of a mixed character placed in other buildings, portions of which ought really to have been exhibited in the Manufactures Building.

In arranging the exhibits great care was taken to keep those of the same class as close as possible together, but owing to the constant alterations which were necessary from exhibitors withdrawing, and others taking their place, in a few instances exhibits were slightly removed from their proper place. The front portion of the section, along the centre aisle, was occupied by exhibitors of pottery and jewellery; behind these came furniture and textiles, and behind these again the exhibitors of chemical and pharmaceutical products, sporting and other guns, and the miscellaneous exhibits.

As mentioned in another part of this report, space was provided in this building for the

Indian exhibitors. A single exhibit from New Zealand was also placed here.

The exhibit of the St. John Ambulance Association, though belonging to Department G, was installed in this building, and a room was provided which was used as an ambulance station in connection with the general ambulance service of the Exposition. Staff-Sergeant Dring, who was sent over from the Association in charge of the ambulance, reported 200 cases as having been treated there. In addition to these, there were other cases of so trivial a nature that no account was taken of them.

Department L was also an extensive one; it included education, literature, engineering, scientific apparatus, music, &c. As above mentioned, it was placed in the gallery of the building. Scientific apparatus was fairly well represented, Mr. Common showing a large telescope mirror, and there being a number of exhibitors of optical, photographic, physical, and other apparatus. A collection of newspapers of all times and countries was shown by Mr. Sell.

In the Liberal Arts Gallery were several loan exhibits of an important character. The floor space of a portion of the gallery was divided off by partitions so as to form several small galleries suitable for the display of the pictures, drawings, maps, &c., of which the most important of these loan collections consisted. One such gallery was filled with the exhibit of educational apparatus and specimens contributed by the School Board for London. The bulk of the collection consisted of specimens of work done by the pupils, but there were also exhibits of school material and appliances, together with models, plans, and elevations of schools and class-rooms, &c. Another room was devoted to the collection contributed by the Science and Art Department, this comprised examples of drawing, painting; &c., by the students in the South Kensington Training Schools, and other schools of art in the United Kingdom. A special photographic collection filled a third, and part of a fourth room. This was formed by a committee, of which Mr. Francis Cobb was chairman, and Mr. Seyton Scott the secretary, appointed with the view of organising a loan collection of photographs which might illustrate the present condition of the art in this country. At the invitation of this committee, nearly all the principal artists in Great Britain, both professional and amateur, contributed works; the collection, consequently, might be considered

to be fairly representative of the present high condition of photography in England, and it was very greatly appreciated by American photographers. It consisted of 205 pictures, shown by 48 exhibitors. A collection of Astronomical Photographs was contributed by the Royal Astronomical Society, and one of Microscopical Photographs by the Royal Microscopical Society. Some drawings of the Milky Way were exhibited by Lord Rosse.

The Ordnance Survey Department sent a collection of maps illustrating their more recent work; and the Geological Survey sent a series of geological maps, with illustrative memoirs. A conspicuous exhibit in this department was the map which had been prepared by the officials of the Geographical Society, at the request of the Commission, to illustrate the discoveries which had been made in North America by men of British birth.

The Commission of Sewers of the City of London sent a collection of models, plans, drawings, &c., relating to the sanitation, &c., of London.

A collection of books, reports, plans, &c., relating to charitable institutions in England, which had been prepared, at the request of the Commission, by Mr. C. S. Loch of the Charity Organisation Society, though appearing in Group 156 (Department L) in the British catalogue, was really handed over to Mr. Rosenau, the head of the Department of Hygiene, for installation in the Ethnological and Anthropological building, as part of a collective exhibit which was under the charge of that gentleman.

The windows at the back of the gallery were utilised for the exhibition of stained glass.

It is satisfactory to be able to report that the British Section was in this as in the other buildings, in point of time, far ahead of all other sections, not excepting the American. It was not indeed entirely complete on the opening day, for many of the exhibitors seemed hardly to realise the great distance which their goods had to be conveyed, and the consequent necessity for their despatching them at an early period. The section, however, was in a very advanced state and quite ready to receive visitors when the building was opened by the President of the United States on the 1st of May.

One reason that the Section was not complete was the fact that some exhibitors who had taken up space but did not utilise it, omitted to notify their withdrawal in time to allow of the re-allotment of the space before the open-

ing. This is a difficulty which occurs at all exhibitions. In the present instance it was more than usually inconvenient on account of the great distance from home. Some delay was also caused by the fact that the building was hardly ready for occupation when the installation commenced. The roof was very far from being waterproof, and there were a good many complaints of damage by leakage. Much of this damage was done in the early spring by the heavy snow which accumulated on the enormous area of roof, and at one time fell in a perfect avalanche on to and through the roof of the side galleries. This, however, happened when but very few of the exhibitors had commenced their installation, and no actual damage was done by the accident itself; it however caused considerable delay, as work could not be carried on in that part of the building until the roof had been repaired. Fortunately the summer throughout was a dry one, and after the early part of the season very little harm was done by leakage.

Some time after the close of the Exhibition (in January, 1894), a fire, which broke out in one of the other buildings, spread to the Manufactures, and consumed part of it. Fortunately, it did not extend to the part occupied by the British Section, but some damage was done by water to the exhibits which were still remaining—packed for removal—in the Section. Had proper facilities for transport been afforded, these would all, or nearly all, have been despatched before the fire occurred.

XXI.—AGRICULTURE.

The Agricultural Building was 900 feet long by 500 feet wide. About 27,000 square feet were originally allotted to Great Britain in it, but as it was found that this was far in excess of the requirements of the Section, it became possible to resign a portion of it, which was allotted to New South Wales. The total area retained was 14,176 square feet. The space was in the centre of the building, and, as was the case in all other buildings, in the most advantageous position possible.

Mr. H. W. Pearson was the superintendent of this division of the British Section.

The exhibits in this department, Department A, included not only agriculture, but food and its accessories, including alcoholic drinks, together with fats, oils, soaps, candles, &c. Of agricultural machinery there were no British exhibitors, our exhibits in this class consisting of food preparations, dairy products, tea, coffee, chocolate, &c., malt liquors,

spirits, and mineral waters. There was also an important exhibit by Mr. Burdett-Coutts, M.P., who showed, in the group devoted to farms and farm buildings, a large model of the Brookfield Stud Farm. Space was found in the British Section for an exhibit of Victorian wool, that colony not having any Commission to represent it.

An important series of diagrams, sent by Sir J. B. Lawes, Bart., and Sir J. H. Gilbert, showing the results obtained over a period of years at the Rothamsted Experimental Farm, were placed in the collective exhibit organised by the U.S. Department of Agriculture, and so were not included in the space allotted to the British Section.

XXII.—TRANSPORTATION.

The Transportation Building proper was 960 feet by 256, and there was also an annexe of 900 feet by 425, in which the railway plant was shown. The amount of space required in this building was arranged with Mr. Willard Smith, the chief of the department, on the occasion of a visit paid by him to this country, the space allotted and occupied being 54,257 square feet—the second largest space occupied by the British Section. Part of this space was in the main building, and part in the annexe adjacent.

The British exhibits were under the charge of Mr. T. Baker, as superintendent. He was appointed to this post on the completion of his duties as Secretary to the Dublin Committee.

The exhibits contained in this building included every means of transportation—railways, vessels, and vehicles; it also included naval warfare and coast defence. We were well represented in almost every group. The London and North-Western Railway Company sent a locomotive and two carriages; the Great Western Railway Company sent one of their old broad gauge engines. As regards road carriages the representation was less complete, the Commission having been disappointed in the hope of a collective exhibit, which there seemed some prospect of organising under the auspices of the Institute of British Carriage Manufacturers. The group devoted to marine transportation was very well filled, a great number of our principal steamship companies and shipbuilders having sent models; amongst these, reference may be made to the magnificent model sent by Sir W. G. Armstrong, Mitchell and Co. Limited, of H.M.S. *Victoria*. There were a large number of exhibitors of bicycles and tricycles, though

not quite so many as had been anticipated from the applications originally made.

A valuable collection of illustrations of old and modern vehicles of various sort was made by the Institute of British Carriage Manufacturers, and lent to the Commission, at whose expense it was brought over and shown.

Other loan exhibits were a Lord Mayor's coach lent by Messrs. Laurie and Marnier, and a model of the Forth Bridge, lent by Sir John Fowler, Bart., and Sir Benjamin Baker, K.C.M.G.

A model of the shield used by Brunel in the construction of the Thames Tunnel was lent by Trinity College, Dublin, but this was unfortunately lost in the ss. *Naronic*.

XXIII.—MACHINERY.

The size of the Machinery Hall, including the annex, was 1,396 feet long by 422 feet broad. In this building 33,000 square feet were allotted to Great Britain. This space was fully taken up in London by sixty exhibitors; twenty of these, however, failed to exhibit, and a space of nearly 6,000 square feet was left vacant. Some of this space was reallocated to exhibitors who came in at a later date, and, as far as possible, a readjustment was made of the previous allotments. Many exhibitors, however, had completed their stands, or had put down foundations, and were not able to shift their position even when a more advantageous space was offered to them. Eventually vacant spaces, amounting in the aggregate to 2,000 square feet, were left.

The British Section in this department was placed under the charge of Mr. H. D. Wilkinson, who was also responsible for the Mining and Electricity Departments.

The Chicago Executive undertook to supply power for driving machinery in motion, but the Chief of the Department, Mr. L. W. Robinson, expressed a strong desire that power for driving the machinery in the British Section should be supplied by British engines, and he undertook that, if the engines were lent and their freight paid to Chicago, all the expenses connected with their installation and working would be defrayed by the administration. The Commission were fortunate in obtaining engines under these conditions from Messrs. Galloways, and Messrs. Willans and Robinson. Messrs. Galloways lent a horizontal compound engine, indicating 350 horse-power, Messrs. Willans and Robinson, provided two of their patent central valve engines, of 360

and 165 indicated horse-power. The details of the performances of these engines are given in a report by Mr. H. D. Wilkinson, which forms Appendix 22. Information as to the conditions on which motive power was supplied is given in Appendix 21.

Messrs. Willans and Robinson also showed one of their 300 horse-power engines coupled to a Siemens Brothers dynamo. This plant was placed at the disposal of the Electrical Department, and supplied current for four large Schukert search lights, which were shown every night on the Manufactures Building, and for other purposes.

The performance of the engines supplied by Messrs. Galloways and Messrs. Willans and Robinson left nothing to be desired, and as each engine was of a distinctive and novel type in America, they both attracted considerable attention. The other exhibits in motion comprised gas and oil engines, steam hammers (the only exhibit of steam hammers in the Exhibition), cotton machinery, looms, sand-blast etching apparatus, confectioners' machinery, dish washing, brick making, and brush-boring machinery, compressed-air plant, with rock drills, together with a large number of standing exhibits.

XXIV.—MINES.

The size of the Mines Building was 700 feet by 350. The space allotted to Great Britain in it was 8,000 square feet, situated, as elsewhere, in the centre of the building. A much larger space had originally been offered, amounting to 25,000 square feet; but, as the number of exhibitors in this department was naturally small, the larger proportion of the space was appropriated to New South Wales and Canada. Though the exhibitors were not numerous, some of them were of a very high character. All the spaces appropriated in London were occupied. Apart from private exhibitors, there were two important contributions from Great Britain, viz., the collections, one of British economic minerals, prepared by Mr. Bennett H. Brough, then of the Royal College of Science, South Kensington, but now Secretary of the Iron and Steel Institute; and the collection, illustrating British metallurgy, prepared by Dr. E. J. Ball, the Instructor in Assaying at the Royal College of Science. Numerous contributions were made to these collections by mine owners and others, to whom special application was made. They were both of them placed among the scientific collections

in the gallery of the Mines Building, not in the space allotted to the British Section, and at the close of the Exhibition were presented to the Columbian Museum.

The exhibits included a very valuable series of specimens and apparatus of the rare metals (valued at £20,000), by Messrs. Johnson and Matthey; coal, iron, and steel, salt, Irish granite, &c. The space occupied was 5,858 feet.

XXV.—ELECTRICITY.

In this department, the building for which was 690 feet by 345 feet, Great Britain was very poorly represented. Special efforts were made by the Electrical Committee, who were anxious to show at Chicago a typical English lighting station, and they also endeavoured to illustrate domestic electric lighting by showing a number of fitted rooms, as has been done in some Exhibitions in this country. They, however, were not successful in either attempt. It had also been hoped that a share in the electric lighting of the Exhibition might be allotted to some British firm, but the negotiations under this head came to nothing. It was by the division of the whole lighting scheme into sections, for which contracts were entered into with different nationalities, that the lighting at Paris was such a representative display. With one or two exceptions, notably in the case of Messrs. Siemens and Halske, who had the contract for lighting the terminal station, the whole of the electrical plant was American.*

In the Electrical Building no steam was furnished or allowed, the idea being that electrical power alone was most appropriate. This secured a grand display for the electrical transmission of power, but was fatal to a large class of exhibits of great importance. Practice in both lighting and power is now almost entirely in direct coupled engines and dynamos, and such plant of this character as was exhibited could either not be run at all, or had to be run by making the dynamo a motor to turn the engine. This affected three exhibits.

The reluctance of English electrical firms to exhibit at Chicago was no doubt due, at all events in part, to the fact that most of them had taken part in the special Electrical Exhibitions which have recently been held at Frankfurt and at the Crystal Palace.

The most important contribution in this department was the collection of historical

* The conditions under which electricity for light or power was supplied to exhibitors are given in Appendix 23.

telegraphic apparatus, lent by Her Majesty's Postal Telegraph Department, and exhibited at the expense of the Commission. The collection included apparatus dating from 1837, and also modern telegraph apparatus, as used at the present day in our telegraph department.

XXVI.—FISHERIES.

In the Fisheries Building this country was very poorly represented. Here, as in other instances, an attempt to organise a collective exhibit of fishing boats and fishing gear from some of our sea-coast towns was unsuccessful. The allotment of space in this building was not received until so late as March, 1893, and consequently definite allotments could not be made to the exhibitors until that time. They had previously been informed that the space they had applied for would be provided for them, but they could not be told in what position their space would be. The result was that one or two of them withdrew at the last moment, and consequently our fishing exhibit was even less effective than it would otherwise have been. The total space occupied was only 1,300 square feet. The exhibits included a model of the School of Fishery at Baltimore, co. Cork; fishing tackle, flies, hooks, cured fish, &c.

XXVII.—CATALOGUE OF THE BRITISH SECTION.

The Catalogue of the British Section was published for the Commission by Messrs. Clowes and Sons. It contained, besides a full classified list of the exhibitors in the Departments of the Exhibition, an introduction to each department, written by a qualified authority on the subject.* These introductions render the book of permanent value, and added greatly to its interest.

As far as possible the classification of the Exposition was followed. In cases where the goods shown came under more than a single group, the entry was made under the group to which the exhibit appeared generally to belong, and under the other groups in which the exhibit should appear, cross references were given.

In the Fine Art Department, as the catalogue was printed before the pictures were hung, the numbering could only follow the alphabetical order of the artists' names instead of the much better plan of following the actual order of the pictures on the wall.

* For list of writers see Appendix 24.

The catalogue (of which 50,000 copies were printed) was on sale in the Exhibition on the opening day, and was the only complete catalogue which was so ready, though some sections of the General Official Catalogue were published at the same time. As a firm of Chicago publishers had obtained a monopoly of the right of selling catalogues in the Exhibition, arrangements for the sale of the British Catalogue had to be made with them, but it cannot be said that the arrangement was very satisfactory in its results. Copies were sent to all public libraries, and a large number of scientific institutions in the States. The cover was designed by Mr. Lewis F. Day. The greater part of the cost of printing and publishing was defrayed by the advertisements it contained.

XXVIII.—HANDBOOK.

In January, 1892, as already stated, the Commission published a Handbook of Regulations and general information relating to the Exhibition generally, and the British Section in particular. Of this, successive editions were issued in April, June, and August, 1892, and in January and May, 1893, increasing in size from 64 pages to 228. The last edition contained a list of the Royal Commission, and the committees appointed by them; a synopsis of the classification; the regulations issued by the Chicago Executive, the United States Customs, and the British Commission; information as to cost, &c., of freight; an abstract of the United States tariff; information as to routes to Chicago; brief descriptions of the Exhibition and the various buildings; and much other general information, such as was considered likely to be useful to exhibitors and to visitors. There was a great demand for this book, which was issued gratuitously, and as many as 17,000 copies were ultimately distributed. It, consequently, proved extremely valuable as a means of disseminating information about the Exhibition in England. Its cost was almost entirely defrayed by means of the advertisements it contained.

XXIX.—WOMEN'S WORK.

The attempt to give prominence to the work of women was a special characteristic of the Chicago Exposition. As was mentioned in a former paragraph of this report, the Act of Congress which created the World's Columbian Commission created also a Board of Lady Managers.

This Board consisted of two members from each State and Territory, with thirty other members appointed by the President and by the city of Chicago.

The first meeting was held in November, 1890, and Mrs. Potter Palmer, to whose exertions the inception and carrying out of the movement was mainly due, was elected President. The Board was supposed to have charge and management of all the interests of women throughout the Exhibition, and it was decided that they were to have representatives on all committees appointed to award prizes for exhibits which were produced in whole, or in part, by female labour.

A special building was erected in the grounds by a woman architect, and in it were shown specimens of female work from the various States of the Union, and the contributing countries.

In reply to the urgent requests of the American Executive, the Royal Commission appointed a committee of ladies to prepare a special collection of women's work from this country, and to co-operate with the Board of Lady Managers in Chicago. H.R.H. the Princess Christian undertook to act as president of this committee (a list of the members of which will be found in Appendix 3), and to her Royal Highness' personal attendance at all the committee meetings, and the great interest she took in the work, must be attributed the large share of success which this department of the British Section certainly attained.

Miss Fay Lankester, Secretary of the National Health Society, was appointed secretary of the British Ladies' Committee, and the efficient way in which she performed the difficult duties of the post fully justified her appointment.

The committee sub-divided itself into the following sub-committees:—Scotch, Irish, Welsh, Needlework, Handicrafts, Lace, Philanthropy, Nursing, Educational, and Literary.

Mrs. Roberts-Austen also undertook the organisation of a collection of pictures by English women artists, and Miss Helen Blackburn made arrangements for the formation of a portrait gallery of famous women.

A grant of £1,500 was originally made by the Commission for the purposes of the Ladies' Committee; this was afterwards increased to £4,250. The Commission also undertook the cost of insurance and freight to and from Chicago of the exhibits under this Section.

The total expense of the section was £5,177, an amount larger, it is believed, than was contributed by any other foreign country to this particular department.

A space of 2,384 square feet was allotted in the Women's Building for the British Section, and in this the greater part of the exhibits collected by the exertions of the committee were shown. There was also a room provided for a very complete and interesting collection of nursing appliances, which had been brought together by Mrs. Bedford Fenwick. The English women's pictures were hung in the great hall of the building, and space was found in the large meeting-room on the upper floor of the building for Miss Blackburn's collection of portraits of eminent British women.

One of the great vestibules of the building was also assigned to the British Ladies' Committee for purposes of decoration, and for it two large mural paintings were prepared by Mrs. Lea Merrett and Mrs. Swynnerton, and the bas-reliefs which embellished the walls were executed by Miss Halle and Miss Rope. The general design of the decoration was left in the hands of Mrs. Roberts-Austen.

Two members of the committee, Mrs. Roberts-Austen and Mrs. Bedford Fenwick, went over to Chicago a month before the opening of the Exhibition, and remained there, the former for a month, and the latter for five weeks. Mrs. Bedford Fenwick's object was to arrange her collection of nursing appliances, while Mrs. Roberts-Austen went out to superintend the decoration of the vestibule.

The Royal Commission and the Ladies' Committee are greatly indebted to those two ladies for so earnestly devoting themselves to the interests of this department of the British Section.

Mrs. Bond, an English lady resident in Chicago, was appointed Superintendent of this Section. Mrs. Cope was sent out as Assistant Superintendent, with special charge of the Department of Needlework and Handicraft. It may be mentioned that the British Section in the Women's Building was complete on the day of opening.

XXX.—INSTALLATION AND GUARDIANSHIP.

A larger share of the work of installation was carried out by the American Executive than has usually been the case. A terminal charge of six cents per hundred pounds was levied on all goods brought into the Exhibition building. This work, the unloading of

goods from the railway trucks, and delivering them upon the exhibitors' spaces, has generally been left to the Foreign Commissions. The method employed at Chicago saved the Commission a certain amount of expenditure, but probably the work would have been more promptly and efficiently done if the Commission had been allowed to do it itself. Railways were laid into the grounds and into some of the buildings, but not nearly to so large an extent as might conveniently have been done. In Paris the lines of rails were carried practically into all parts of the grounds, and the goods delivered so near each space that no carting was requisite. It is true that this only applied to goods which came by one railway line, those brought by other lines had to be carted to the Exhibition grounds. At Chicago practically the whole of the goods were unloaded from the railway trucks and loaded on waggons, which were driven into the buildings and discharged their freight wherever it was required. In several instances damage was done by these waggons, but not to any serious extent. It is certain that it would have been much better if railways had been laid more extensively over the grounds, and if they had been allowed to remain to a later date than was the case. Some of the lines were cleared away a considerable time before the opening, but after this was done it was found necessary to allow the rest to remain for some time after the Exhibition had been opened.

The charge of the Exhibition grounds was in the hands of a special body, known as the "Columbian Guard," under the command of Colonel Edmund Rice. The legal position of this body of men seems to have been somewhat uncertain, but practically they acted as a police force, and carried out their duties extremely well; though those duties, so far as related to keeping order in the grounds, were extremely light, the orderly character of the American people being such as to render police control—even when there were large crowds—almost unnecessary. This was especially remarkable on the occasion of the opening ceremony, and on the Chicago Day, when three-quarters of a million visitors entered the grounds.

There were a few cases of theft from the exhibitors' stands, but none of any importance, probably less than the average at great exhibitions. At the close of the Exhibition the removal of the goods was effected in the same way, though much less promptitude was displayed.

XXXI.—AWARDS.

To deal with the question of awards a Committee on awards was appointed by the National Committee, and of this committee Mr. John Boyd Thacher was made chairman.

In order to ascertain the merits of the exhibits an entirely new system was adopted; instead of the old plan of juries it was decided that each exhibit was to be referred to a single judge whose award was practically to be final. It was also decided that all the awards should be of one grade, and that each should consist of a bronze medal and a diploma on which was to be stated the reasons for the award as made by the judge.

The objections to such a system were obvious to all who had any experience, as soon as it was made public, and strong protests were urged against it by the Foreign Commissioners and by the American exhibitors, protests which the issue proved to be but too well-founded.

It is evident that, with a number of individuals thus working independently, no uniform standard could be hoped for and none was obtained. It has always been a difficulty to secure uniformity or any approach to uniformity in the awards made in different departments of exhibitions, but the jury system has always been successful in obtaining that essential in the awards made by the jury of each department. It was also obvious that the proposed system offered no security whatever against bad faith or incompetence.

In a large number of judges, selected for so many different reasons, and appointed by so many different authorities, it could not but be expected that a certain proportion would be incompetent. A few incompetent persons upon a jury do little or no harm, but an incompetent judge, acting by himself, may certainly do grievous injustice to an exhibitor. For instance it may happen that a judge, competent to deal with certain subjects, have allotted to him, and be required to deal with, matters outside his own range of knowledge.

The responsibility which was thrown upon individuals was unfairly great. Naturally, many men, of the highest honour and capacity, would shrink from affixing their name to criticisms upon the goods of a rival in trade, or to laudatory comments on the wares of a possible employer. Nor would exhibitors be likely to accept readily the judgment of a rival, or of an expert connected or interested in some rival house.

These are some of the more obvious objections to the one judge system, and objections were also taken to the single medal plan. It was urged, and not without justice, that the only persons who would be benefited by the single medal would be the inferior manufacturers, who were raised to the same level as their more capable competitors; while these had nothing to gain from an award which was shared by exhibitors admittedly of a lower grade. In practice all these objections were more than justified.

In some cases the judges practically refused to adopt the system, formed themselves into committees, and made the awards on the old system, merely complying with the regulations so far as to share among themselves indiscriminately the responsibility of signing the several reports.

In other cases some judges took a high standard and refused to make awards, except to a small proportion of selected exhibits; others took a low one and gave medals to practically all the exhibits they were set to examine.

It was a mere accident whether an exhibitor had his goods examined by a single judge and received a medal, or whether he was lucky enough to get half a dozen judges to his stand and get half a dozen medals.

In some cases medals were granted to each specimen in a collective exhibit; in others a medal was given for the collective exhibit itself.

Nor was the system satisfactorily worked. A definite promise was made that every exhibitor should have at least seven days' notice of the visit of the judge. This would have been difficult to carry out under any circumstances. As a matter of fact most exhibits were visited without any notice at all, and many the absence of the exhibitors.

The result of the system, and the way in which it was worked, was shown by the fact that instead of awards being announced, as has always been the case hitherto, some time before the close of the Exhibition, the official list was not published till six months after the Exhibition was closed. It is true that the awards in various sections were announced from time to time, but the lists thus issued seemed to have no official authority, and were incomplete and liable to change.

This delay was a great hardship to exhibitors, who lost the advantage—whatever that advantage may amount to—of announcing the successes on their stands during the closing period of the Exhibition. Nor was the hardship lessened by the fact that some fortunate

individuals received the information, while others were left in ignorance.

As fast as any information was obtained by the Secretary of the Commission, it was communicated to the exhibitors or their representatives on the spot, but this partial information was never satisfactory, and its accuracy could never be relied on.

It was at first announced that the names of the judges to be appointed by foreign Governments or Commissions would be required by March 15, great stress being laid on the importance of getting the work of judging finished at an early stage of the Exposition, so that exhibitors might have the advantage of being able to advertise on the stands, during the Exhibition, the medals which they had gained. This excellent idea, however, proved impracticable of realisation, and the commencement of the work of judging was deferred, first, to the 1st June, afterwards, to the 15th June, and, finally, to the 15th July; while, as a matter of fact, it was hardly completed when the Exhibition was closed.

An arrangement was arrived at with the Committee on Awards, under which Great Britain was to have forty judges, a like number being allotted to France and to Germany. Each foreign judge was to be paid \$750 (£150). As the French exhibits were withdrawn from competition, no French judges were actually appointed. It was also arranged that three lady judges were to be designated by Great Britain. In the result, only 38 judges in all, including the three lady judges, were appointed. A list of these is given in Appendix 25. Four of these judges, who really represented colonial interests, were included in the list of British judges, as there were sufficient vacancies to allow this to be done. These were Mr. Adam Brown, who represented Jamaica; Mr. F. Shutt, of Canada; and Mr. Quelch and Mr. Vincent, the Commissioners for British Guiana and Trinidad respectively. These appointments were all made at the special request of the Colonial Commissioners. Mr. Grinlinton, the Commissioner for Ceylon, was also desirous of nominating two jurors to represent that island, and two of the remaining three vacancies were placed at his disposal. Circumstances, however, prevented him from making the proposed nomination. Some judges were also appointed by the Colonial Commissioners.

The great assistance rendered by the British judges was fully recognised by the American executive, and the Commission feel

that their cordial thanks are due to the body of distinguished gentlemen who undertook what must always be an arduous and rather thankless task.

There was an unprecedented delay in announcing the awards. It was not until the middle of April, 1894, that a complete list was received.* As the judges reported, provisional and partial lists were suspended in the offices of the Committee on Awards, and a more or less complete list of British awards was afterwards sent to the Secretary for correction. There are, however, many discrepancies between the first and final lists, and the final list does not clearly indicate the number of awards made to each exhibitor in those cases where more than a single award has been made to the same firm. So far as can be ascertained, it appears that about 1,183 awards have been made in the British Section (exclusive of the Colonies and India). Of these, 705 were in the industrial departments of the Exhibition, and were divided among 491 exhibitors. The total number of industrial exhibitors was 597. Of 501 exhibitors in the Fine Arts Department, 130 received awards; of 1,138 exhibitors in the Women's Work Section, 182 received among them 225 medals; 159 awards went to Indian manufacturers represented at Chicago either independently or in the Indian Pavilion, and 56 to Indian exhibitors in the British Section; 55 awards went for British exhibits (like Mrs. Ernest Hart's Donegal village) not under the jurisdiction of the Royal Commission.†

XXXII.—DECORATIONS.

The funds at the disposal of the British Commission did not allow of such elaborate decorations in the parts of the buildings at their disposal as other Commissions were able to prepare. Most of the other countries had undertaken the construction of costly pavilions, for the reception of their exhibits, within the buildings, especially in the Manufactures Building. There can be no doubt of the superior attractiveness of this method, although it may be a question whether it was not carried to excess at Chicago, and whether the general effect of the main building did not seriously suffer from its being filled up with these interior buildings. The exhibits

also received less attention in consequence of the nature of their surroundings.

A more serious objection was the delay caused by the erection of these elaborate constructions. It was not until the month of July that the building operations of certain of the foreign Commissions were completed, and during all the time there were going on those exhibitors who had been ready by May 1 had to suffer great inconvenience from the inevitable dust and dirt thereby occasioned. This, indeed, is no objection to the system, only to the manner of its execution, for it is evident that works of such elaboration should have been commenced months before.

It is, indeed, but fair to state that the delay in completing these interior pavilions was partly due to the fact that no information was available, in spite of repeated applications, until December, 1892, as to whether any uniform system of decorative treatment would be recommended by the American Executive. In that month a scheme was submitted, but the necessary preparations of many of the exhibitors were then too far advanced to admit of alteration, and the German and British Commissions both found themselves unable to agree to its adoption. Had the same proposal been put forward at an earlier date, means might have been found for carrying it out, and a much finer general effect would certainly have been produced in the building.

This will have to be borne in mind in the preparation for future Exhibitions, and future Commissions will have to be much more richly endowed if they are expected to expend large sums on the decoration and fitting-up of their courts. The very striking pavilions erected by France and Germany were greatly and properly admired, but their construction involved an expenditure far beyond any resources which have ever been placed at the disposal of any Exhibition Commission from this country.

For the British Section little constructive work was attempted, indeed only such as was required for the loan collections of which the Commission had charge. Despite this it certainly presented as attractive an appearance as at any previous Exhibition, for the exhibitors generally went to a greater expense than usual, and devoted more than ordinary care and cost to the construction of their stands and pavilions. A large proportion of these were of a very ornate character, especially in the Manufactures Building, where our Section certainly contained some of the finest and most elaborate pavilions set up by any individual exhibitors.

* See Appendix 26.

† The numbers of awards made at different Exhibitions, varies considerably. In Vienna, in 1873, 466 awards were made to the British Section; in Philadelphia, in 1876, 587 awards; in Paris, in 1878, 1,694 awards; in Paris, in 1889, 526 awards.

The Commission desire to record their opinion that on future occasions it will be desirable that efforts should be made to arrange for some harmony of design among the various exhibitors in each section as to the character of the structures erected by them.

In the building were placed the banners lent by seventy-six Municipal Corporations of the United Kingdom, and they formed a most interesting addition to the decorations of the Section. These banners, each of which bore the historic arms of one of the ancient municipalities, were lent by the Corporations enumerated in Appendix 34. Many of them were specially prepared for the occasion, others had served a similar purpose at Paris in 1889. Several banners were also lent by certain of the Livery Companies of London. These are also enumerated in the Appendix.

The arms, shields, and escutcheons used in the decoration of the British Courts, were specially designed by Mr. Lewis F. Day, and were of a very artistic character.

XXXIII.—STORAGE OF EMPTY CASES.

The question of the disposal of the cases in which the goods are brought to an Exhibition is always troublesome. These cases are, of course, very numerous and very bulky. They have to be cleared away rapidly, as fast as the goods are unpacked, for their accumulation is a serious hindrance when work has to be pushed on hurriedly in a limited space. They should be stored, so that those belonging to each exhibitor are accessible at any time without great difficulty, and the arrangement should be such as to ensure their prompt and speedy delivery immediately the Exhibition is closed.

The usual practice has been to allow foreign Commissioners to make their own arrangements, but the Chicago Executive preferred to take this responsibility upon themselves, and organised a service for the removal and storage of the cases. So far as the British Section is concerned, there can be no doubt but that the exhibitors would have been saved a great deal of trouble and expense had foreigners simply been afforded facilities for making their own arrangements. There was much difficulty in getting rid of the cases during the installation period, and very serious delay in obtaining them at the close.*

* The charge for storage was $4\frac{1}{2}$ cents per cubic foot, or 4s. 9d. per cubic yard, without insurance, but afterwards a rebate of nearly half this amount ($10/36$ ths) was allowed, so that the actual charge was about 2s. 8d. per cubic yard. In Paris, 1889, the British Committee charged 2s. 6d. a cubic yard

XXXIV.—CUSTOMS DUTIES.

The general principle adopted with regard to Customs duties was that the Exhibition grounds were to be considered as a bonded warehouse. All exhibits were allowed to be brought over duty free, but if any sales were effected the ordinary duty was to be charged upon them.

The way in which the regulation was carried out was that as each package of goods arrived it was opened in the presence of a Customs officer, and the goods checked with the invoice, so that at the close of the Exhibition the absence of any goods from the original package might be detected and duty charged upon them.

The work at the opening was fairly well carried out. There was a sufficient staff of officials to prevent any great delay in the examination, and the regulations on the whole were interpreted with liberality and courtesy. Mr. J. W. Clarke, the Collector of Customs at Chicago, was at the head of this department, and he at all times showed himself willing to give any reasonable facilities.

At the close of the Exposition the goods were in the same way packed under the superintendence of the Customs officials, before the packages were delivered to the railway companies for conveyance to the sea coast.

There was a good deal more delay and more trouble at the closing than at the opening. At first the staff was insufficient, and there was a vexatious tendency to insist on the employment of regular Custom-house brokers, and thus to compel exhibitors to pay heavy and unnecessary fees. Great and unnecessary delay was caused by the officials insisting on compliance with their very elaborate code of regulations, even in the case of official exhibits, where the risk of smuggling was, to say the least, inconsiderable.

The question of the sale of goods, always a troublesome one at Exhibitions, was complicated by the strict Customs regulations. The rule laid down at the commencement was that no sales for immediate delivery would be permitted within the Exhibition grounds, but that goods might be sold for delivery at the close. As has nearly always been the case, this regulation could not be carried into effect, and the difficulty of carrying it out was increased

(cases over a cubic yard 1s. for every yard after the first), and included insurance against fire. The committee lost £560 on the transaction, but the cases were removed day by day as they were emptied, and the delivery of them commenced the first day after the Exhibition was closed.

by the fact that the administration granted concessions for the erection of stalls in the buildings and grounds for the sale of goods of various descriptions. In many of the foreign sections this regulation was practically ignored, and goods were openly sold. This being the case, a strong representation was made to the Director-General, and it was pointed out to him that the rule would not be enforced in the British Section unless compliance with it was insisted upon elsewhere. After this protest, there was no interference on the part of the British executive with those exhibitors who desired to sell, and eventually the rule was relaxed and sales of goods on which Customs duty had been paid were permitted.

Some hopes were at one time entertained that a more liberal view would be taken by the Treasury authorities at Washington, and that a reduction would be made on the heavy dues exacted. Indeed a Bill was introduced into Congress, granting a rebate of half the duty in respect of all dutiable goods sold at the Columbian Exposition, but the Bill, after passing the House of Representatives, was hung up in the Senate. The full duties were therefore exacted.

XXXV.—TRAFFIC ARRANGEMENTS.

The American railways undertook to bring back, free, packages which they had carried from the seaboard to the Exhibition, and the various railways agreed upon a uniform tariff of rates. The British railways agreed that goods sent by British exhibitors to the Exhibition should be carried to and from the port of embarkation at half rates. The principal steamship companies also agreed to a uniform rate for exhibitors' goods of 10s. per ton, with 10 per cent. primage. This concession, however, was in some cases withdrawn. Many of the companies also agreed to a special passenger tariff for exhibitors and their employees, the reduction amounting to about 10 per cent. of the usual first and second class fares.

XXXVI.—ALIEN LABOUR LAW.

The laws of the United States do not allow the landing of any foreigner under contract to perform work of any kind, and if they had been enforced, it would have been impossible to have brought in either workmen to carry out any work which the Commission might require, or persons in charge of exhibitors' goods.

In August, 1892, a joint resolution was passed through the Senate and House of

Representatives, authorising foreign exhibitors to bring foreign labourers from their respective countries, for the purpose of preparing and taking charge of exhibits. This Resolution is given in Appendix 32.

No difficulty was found in carrying out the provisions of the Resolution, and no difficulty seems to have been made in any case about the admission of foreigners under contract to perform duties at the Exhibition.

XXXVII.—EXHIBITORS' EXPENSES.

In 1876, Sir Herbert Sandford obtained from British exhibitors at Philadelphia some valuable information as to the expenditure incurred by individual exhibitors. This enabled him to form an estimate of the total amount expended on the British Section at Philadelphia, and the total value of the exhibits.

The total value of the exhibits he set down as £250,000, and the expenses incurred by exhibitors as £120,000. This would give an average for each of the 624 industrial exhibitors of about £400 value of goods and £190 expenses.

In answer to a similar inquiry 333 replies have been received from Chicago exhibitors. These return a value of £238,492, and expenses £115,620. This gives for each exhibitor an average value of exhibit £716, amount of expenses £347.

Applying these figures to the whole of the Section we find that the exhibitors must have shown goods of the value of about £430,000, and expended in showing them about £208,000. The figures of course do not include Fine Arts.

XXXVIII.—BRITISH DAY.

Special days were assigned by the American Executive to the countries taking part in the Exhibition, and to each of the States of the Union. On these days, there were celebrations, held by the respective Commissions, consisting, generally, of a procession in the city or in the grounds of the Exhibition, and a public meeting in the Exhibition itself. The 19th August was allotted to Great Britain, that day being selected because there was more probability of a number of the members of the Commission being able to be present at Chicago at that date. The unfinished condition of the Exhibition made it out of the question to hold such a celebration on the day which naturally suggested itself for such a purpose, Her Majesty's birthday, which, however, was celebrated by a banquet,

given by Mr. J. Dredge and Mr. W. H. Harris, the two Members of the Commission who were at Chicago at the time, to the principal officers of the Exhibition, the Foreign and Colonial Commissioners, and other important personages.

On the 18th August, 168,861 visitors entered the Exhibition, that being the largest number, up to that date, with the exception of the 4th July. That so large a number was collected together, was due to the exertions of a committee, formed from among the members of the branches in Chicago of the various British Societies, the chairman of which was Mr. George E. Gooch. By this committee invitations were addressed to the other branches of the societies throughout the United States, and a large number of delegates were sent in response from all parts of the Union.

The proceedings included a procession in the city itself, and a large meeting in the Festival Hall, in the Exhibition grounds, under the presidency of Colonel Sadler, H.B.M. Consul at Chicago. At this meeting Mr. Carteighe, Professor Elgar, Professor Le Neve Foster, and Mr. W. H. Preece represented the British Commission, and there were also present all the Colonial Commissioners who were in Chicago. Speeches were made by Colonel Sadler, the Mayor of Chicago (the late Mr. Carter Harrison), Mr. Gooch, Sir Henry Wood (on behalf of the British Commission), Mr. Tassé and Mr. Cockburn (Canada), Dr. Renwick (New South Wales), Mr. Grinlinton (Ceylon), Mr. Quelch (British Guiana), Mr. Vincent (Trinidad), and Mr. Blechynden (India). The enthusiastic loyalty of this meeting made a marked impression on all who were present, and showed how deep a devotion to their Queen and country is felt by British residents in America.

An interesting feature of the day was the "Trooping of the colours" in front of Victoria-house by the men (all time-expired soldiers) of the British Tournament then performing in Chicago.

XXXIX.—CONGRESSES.

A very elaborate scheme of Congresses was drawn up by a body entitled the World's Congress Auxiliary, of which Mr. C. C. Bonny was president. The scheme of the Congresses, which were held continuously from the end of May until the latter part of October, covered the whole range of human knowledge.

The Congresses themselves were held in the new building of the Chicago Art Institute, in

aid of the construction of which a grant was made by the Exposition Company.

This building is on the lake front, in the centre of the city of Chicago, some seven miles distant from the nearest part of Jackson-park.

The anticipations of the promoters of the Congresses that this arrangement would lead to their being largely attended were not realised, for comparatively few of the visitors to the Exhibition took part in the Congresses, which would certainly have been more numerous had they been held in Jackson-park itself.

Many representatives, however, came from different parts of America and foreign countries specially for the Congresses, and the whole series was certainly the most elaborate and complete that has ever been held. To some of the Congresses representatives were nominated by the Commission. A list of these representatives is given in Appendix 27.

Among the important Congresses were the Engineering and Electrical, the latter comprised an inner Congress, called the Chamber of Delegates, which was official and international. It resulted in the adoption of the British Association system of electrical units and standards by the United States Government.* The Royal Commission was able to offer the hospitality of Victoria-house to the final meeting of the Chamber of Delegates, and Mr. Preece gave a reception to the whole Electrical Congress, numbering over 300 members.

XL.—SOCIETY OF ARTS' EXCURSION.

Messrs. Thomas Cook and Son, who had been appointed Passenger Agents to the Commission, organised, at the request of the Commission, a special private excursion to Chicago for the members of the Society of Arts. This excursion started from England on the 2nd of July, returning on the 23rd of August. Forty-one members took part in it. The party visited New York, Philadelphia, and Washington on the way to Chicago, and Niagara on the way back. The members composing it expressed themselves as entirely satisfied and very greatly pleased with the arrangements made by Messrs. Cook for their comfort, and the manner in which the excursion had been carried out.

XLI.—EXHIBITION OF LIVE STOCK.

Very complete preparations were made for

* The Report of the Chamber is given in Appendix 28

an important exhibition of Live Stock, and such an exhibition on an extended scale was held in the large and convenient pavilion specially erected for this purpose. The shows continued from the latter part of August to the end of October, the aggregate value of the prizes being about £50,000.

The contributors from Europe were not very numerous. The question of sending over animals from this country received a great deal of attention from the Agricultural Committee, which was presided over by the Earl of Faversham, President of the Royal Agricultural Society of England. Mr. Ernest Clarke, the Secretary of the Society, served as the energetic honorary secretary of the Committee, which held many meetings at the rooms of the Society in Hanover-square, London. The programme of the proposed Live Stock Exhibition was carefully considered by a sub-committee, and a number of suggestions, which it was thought would facilitate the transmission of British live stock, were made to the Executive at Chicago. Some of these suggestions were acted upon, but others, unfortunately, did not commend themselves to the Department of Agriculture. The difficulties attendant upon the transport of live stock to such a distance, and especially the necessity for keeping them in quarantine for a period of ninety days, prevented many intending exhibitors from taking part in this department.

XLII.—COLUMBIAN MUSEUM.

Before the Exposition was closed, a movement was started in Chicago for the purpose of forming a Museum, in which might be preserved a selection from the exhibits. Owing to the liberality of several prominent Chicago citizens, the project was successful, and arrangements were made for the establishment of a permanent Museum, to be called the "Columbian Museum." It is understood that one or more of the buildings of the Exposition (probably the Fine Arts Building) will be appropriated for the purpose; and a large number of valuable and interesting contributions have been made by exhibitors, foreign Commissioners, and other bodies. A list of the British exhibitors who have made gifts from their exhibits is given in Appendix 31.

XLIII.—CLOSING OF THE EXHIBITION.

It was intended that a ceremonial of some elaboration should mark the closing of the Exhibition on the 30th October. All prepara-

tions had been made, but on Saturday, the 28th, the Mayor of Chicago, Mr. Carter Harrison, was murdered in his own house, by a disappointed candidate for municipal office. In consequence of this melancholy event, the proposed ceremonial was abandoned, and the closing ceremonies were of the briefest and most formal nature.

XLIV.—STAFF OF THE BRITISH SECTION.

The Commission received from the Secretary a very favourable report as to the manner in which the members of the executive staff discharged their duties, and they desire to express their satisfaction on that account. The names of all of are given in Appendix 5. They have also to express their appreciation of the services of Colonel Grover, and their regret at his sudden and unexpected death.

XLV.—CONCLUSION.

Those who did not visit Chicago cannot understand the enthusiasm which was aroused by the Exhibition, or credit its genuine character. The exaggerated laudation of the newspapers produced a natural tendency to disbelief; yet, when every allowance is made, it remains a fact, that the people of Chicago did produce a display, unequalled in many characteristics, and, in many respects, distinctly superior to any previous similar attempt.

The Chicago Exhibition was not merely the largest, but it was certainly the most magnificent Exhibition since the first of all Exhibitions in 1851. Criticism of many shortcomings would be easy enough, but, after all faults had been found, it is not to be denied that this great undertaking was courageous in its inception, splendid in its execution, and successful in its result.

In Europe it was certainly not appreciated at its proper value. The interest which had been aroused by the first announcement of the Exhibition, and by the preparations for it, seemed to fall dead after the opening. Part of this was, no doubt, due to the incomplete condition of things when the Exhibition was opened. The buildings themselves were not entirely complete, and, in many parts of them, the installation of the exhibits had hardly commenced by the first of May.

Many English newspapers had sent over representatives to be present at the opening. The reports sent by these gentlemen were of necessity unsatisfactory, and the impression thus created prevailed over the whole duration

of the Exhibition. Then, too, it must be remembered that all information about American matters comes to Europe from the Eastern States, and they, at first hostile, were never very friendly disposed towards Chicago and its Fair.

Thus it came about that the value of much of the energetic work which had been done by the promoters of the Fair, in advertising it before it was opened, was practically lost.

The Exhibition was, indeed, fully appreciated in America; at all events, in Western America. The people not only of Chicago, but of Illinois and the neighbouring States, were justifiably proud of their achievement, nor did they hesitate to give full expression to their sentiments in every manner available.

In all the earlier Exhibitions the exhibits themselves were held to be the sole, or almost the sole, attraction; it was sufficient if the buildings furnished suitable shelter, and were not unsightly in themselves. At Chicago the great feature was the unique arrangement of the frame of the picture. In all comments upon the Exhibition it was the general effect, the splendour of the buildings, the beauty of the situation, which was remarked upon, not the importance or the beauty of the exhibits and the evidence they afforded of industrial or scientific progress.

It was at Paris that this idea was first developed to any extent; at Chicago it was carried almost into excess. Enormous sums were lavished on splendid, but temporary, palaces and pavilions, not by any means particularly well adapted for their ostensible purpose, but impressive and magnificent in appearance, singly or in conjunction with the rest.

Hardly any one of the Chicago buildings, except, indeed, the Fine Arts, was suitable for Exhibition purposes. The great Manufactures Building dwarfed the exhibits within it, and was dwarfed by the great structures set up inside it. There was nothing like the fine range of galleries in which the French industrial exhibits were shown in Paris in 1889—galleries than which no buildings could be better adapted for their special object.

Nor does this criticism apply to the great Exhibition buildings alone. The numerous and costly pavilions set up by the different States of the Union followed the same intention. As a means of illustrating the natural or manufactured products of the States these buildings were useless; nevertheless, they satisfied the feeling of State patriotism, and

were greatly admired, each by the citizens of the State it represented. The rivalry between the different components of the great American Union is very keen, and it was shown in Chicago by the anxiety of each State to outdo its neighbour in the appearance and character of its building.

The same feeling, too, governed the character of the interior fittings and decorations. The rivalry between the different countries seemed to be—not who could show the finest goods, the newest machinery, the most important invention, but—who could erect the most attractive and elaborate structure. It was the manner of showing the goods, not the merit of the goods themselves which was considered; hence those countries had an advantage in which the Government was the principal or the sole exhibitor, not those who relied upon individual manufacturers. In the former case the exhibit of a country could be treated as a unit. In the latter, uniform treatment was, at all events, difficult.

A lesson may certainly be learned for guidance in the administration of future Exhibitions. If it is desired to make an imposing display it must be done by the subordination of the individual exhibitor to the general effect. Inasmuch as this is not to the advantage of the individual, though it is best for the country in general, it is doubtful whether English exhibitors will ever agree to such a system, but if they do not they must be content to see public attention attracted by the better organisation of their rivals. Trade seems to depend now almost wholly upon advertising; Exhibitions are gigantic advertisements, and those nations who utilise them most skilfully get the most benefit out of them.

This of course means a considerable expenditure by the Government and a reduction of the cost to the exhibitors. It is certain that a more effective display might have been made by this country at Chicago if a portion of the money spent by the exhibitors had been paid into a central fund and expended under their supervision for the common benefit of the Section. Whether this would have been more or less advantageous to the individual manufacturers who exhibited is another question. At all events it is to be remembered that an exhibiting firm advertises not only its own wares but the wares of the country it represents, and English trade as a whole benefits from the exertions of the few of its representatives at a foreign exhibition

Probably in the long run more advantage would be gained if the several trades would recognise this fact and would see that it is their duty to exhibit collectively. The rivalry one against another ought to be forgotten for the moment or merged in a general effort to compete successfully with the representatives of other countries.

Another great feature of the Chicago Exposition was the extent to which amusement was provided for the visitors. Here, again, was an elaboration of Paris. In the older Exhibitions the exhibits formed the attraction; now, people have to be attracted to see them by every means. This system was no doubt commenced in the South Kensington Exhibitions, where first electric light was used for exhibition purposes, and evening opening became possible. It was carried to a much larger extent at Paris, and received its full development at Chicago. There the title of "World's Fair" was fully justified. The large area of the Exhibition given up to the purposes of amusement resembled nothing so much as a gigantic fair; every country on the globe contributed something; there were sights and shows of every sort from everywhere. Still it would not be fair to attribute the great crowds who visited the Exhibition simply to the amusing side of it, for though the Midway-plaisance was the most crowded part of the Exhibition, the picture galleries were always full, and so were the Manufactures and the other main Buildings.

The final question of an Exhibition, as it is the first which is asked when the idea of an Exhibition is set on foot, is as to the advantage to be gained by it. Of the advantage to Chicago, and, indeed, to the Western States of America, there can be little doubt. Chicago desired advertisement, and she had it; the name of the city is known now all over Europe, in quarters where two years ago it had hardly been heard of. Whether there is any genuine profit to be made out of this, remains to be seen. In the matter of actual pecuniary profit, it is probable that Chicago gained a good deal. The city and the inhabitants subscribed, perhaps, 8,000,000 dollars; but much more than this sum must have been brought in by the foreigners and the visitors from distant parts of the country.

And the great bulk of visitors profited, if not in money, at all events in knowledge and education. To the laborious people of the Western wheatfields, familiar with what surely seems to us the dullest and dreariest form of human

existence, absolutely ignorant of the arts and luxuries of life, the Exhibition was a revelation. No such opportunity had ever been offered the people of the Western States of seeing the latest results of civilisation; what had been done by science for the amelioration of human life; what had been done by art for its adornment. They availed themselves of the opportunity to the full. They came in thousands, ready to profit by all they could see; and the lessons which they took back to their western homes will certainly not be without an abiding effect on the future of American civilisation.

To foreigners, on the other hand, it is a more important consideration whether they gain any material advantage from an International Exhibition such as that just concluded at Chicago. That if one of the great trading nations of the world takes part in an Exhibition, the others must do so is a foregone conclusion. It is certain that had we not taken a prominent part at Chicago the results would have been disastrous to our trade. But we had less to gain than any of our rivals. The problem for British commerce is to hold what we have gained. The problem for that of other countries is how best to obtain a share of what we now hold.

In a protectionist country an International Exhibition is something of an anomaly, but that is all the more reason that those who profit by free trade should avail themselves of the opportunity to read the protectionists a lesson. It can hardly be doubted that the evidence afforded at Chicago of the vastly cheaper rates at which many classes of goods could be obtained, were they imported instead of being produced in the country, made a profound impression on many shrewd observers. From this one cause alone we may expect considerable advantage to our trade.

That so small a number of foreigners visited the Exhibition was a disadvantage to us. Our exhibitors were able to appeal only to the American public, not, as was reasonably expected, to a public gathered from all parts of the world. Yet, even then, it must be remembered that the United States, spite of tariffs, remains England's best customer among foreign nations, and that it is far more important for us to stand well in her markets than in the markets of any other country. Hence it may be taken for certain that we were well advised in making the efforts which were made to stand well at Chicago, and we may feel assured that those efforts will not be without useful practical

results. It may be added that we should have been wiser still had our manufacturers been less inclined to dread the effects of protectionist tariffs, and if a larger number had come forward to take their share in maintaining the position we have taken on so many previous similar occasions.

The rivalry at Chicago was keener than ever before. Never have our manufacturers had to meet competition so powerful and so

well organised. . But if the task was more difficult, its accomplishment may be considered as the more satisfactory, and, as it may be hoped, so may it reasonably be expected, that the care expended and the expense undertaken by so many of our leading manufacturers may not be without their due reward, both to the individual competitors and in their wider results on the trade and commerce of the country.

Sealed with the Seal of the Society for the Encouragement of Arts,
Manufactures, and Commerce, this Tenth day of May, One Thousand
Eight Hundred and Ninety-four, in the presence of } (L.S.)

RICHARD E. WEBSTER, *Chairman of Council.*

HENRY TRUEMAN WOOD, *Secretary.*

Appendixes.

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|---|---|
| <ol style="list-style-type: none"> 1. Royal Commission Warrant. 2. List of Royal Commission. 3. List of Committees. 4. List of Local Committees. 5. Executive Staff. 6. List of Colonial Commissioners. 7. American Executive. 8. Synopsis of the Classification. 9. General Regulations. 10. Regulations of the British Section. 11. Financial Statement. 12. Finance of previous Exhibitions. 13. Grants by Foreign Governments. 14. Description of Victoria-house. 15. View and plans of Victoria-house. 16. Map of Jackson-park. 17. Sizes of the Buildings. | <ol style="list-style-type: none"> 18. Table of Colonial Space. 19. Complimentary List. 20. Lenders of Pictures. 21. Supply of Motive Power. 22. Engines in the British Section. 23. Supply of Electricity. 24. Authors of Introductions in the Catalogue. 25. List of British Judges. 26. List of Awards. 27. List of British Congress Representatives. 28. Report of Electrical Congress. 29. The Society of Arts. 30. Dedication Ceremonies. 31. Donations to the Columbian Museum. 32. Alien Labour Law. 33. List of Books on the Exhibition. 34. List of Banners lent to the British Section. |
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APPENDIX I.

ROYAL COMMISSION WARRANT.

The warrant appointing the Council of the Society of Arts, a Royal Commission for the Chicago Exhibition, 1893, was published in the *London Gazette* of Friday, August 28th, 1891, as follows:—

VICTORIA R.

VICTORIA, by the Grace of God, of the United Kingdom of Great Britain and Ireland Queen, Defender of the Faith, to the President, Vice-Presidents, Treasurers, and other Members of the Council for the time being of the Society for the Encouragement of Arts, Manufactures, and Commerce: Greeting!

Whereas it has been notified to Us, through Our Secretary of State for Foreign Affairs, that the President of the United States of America, pursuant to an Act of Congress, has made Proclamation that an Universal Exhibition of the Works of Industry and Agriculture, as well as of the Fine Arts, will be held at Chicago, in the State of Illinois, in the United States of America, in the year one thousand eight hundred and ninety-three, and has invited Great Britain and Her Colonies to take part therein by appointing Representatives thereat, and sending such exhibits as will most fully and fitly illustrate their resources, industries, and progress in civilisation:

And whereas it is Our wish that such Exhibition shall afford full and suitable representations of the Industry, the Agriculture, and the Fine Arts in Our United Kingdom of Great

Britain and Ireland, Our Colonies and Dependencies in Europe, Asia, Africa, America, and Australasia, and that Our subjects shall take part in such Exhibition:

Now know ye that We, considering the premises and earnestly desiring to promote the success of the said Exhibition, and reposing great trust and confidence in your fidelity, discretion, and integrity, have authorised and appointed, and by these presents do authorise and appoint you, the President, Vice-Presidents, Treasurers, and other Members of the Council for the time being of the Society for the Encouragement of Arts, Manufactures, and Commerce, to be our Commissioners to distribute full information as to the best mode by which the products of the Manufacturing and Agricultural Industries and the Fine Arts of Our Kingdom of Great Britain and Ireland, and of our Colonies and Dependencies, may be procured and forwarded for exhibition; to assist with your advice and co-operation: and generally to promote the success of the said Exhibition.

And Our will and pleasure is that you, the said Council of the Society for the Encouragement of Arts, Manufactures, and Commerce, do report to Us in writing, under the Seal of the Society, all and every the several proceedings of yourselves had by virtue of these presents.

And, lastly, We do by these presents ordain that this Our Commission shall continue in full force and virtue until the close of the Exhi-

bition, and until the various proceedings in connection therewith shall have been properly concluded and brought to an end; and that you, Our said Commissioners, or any three or more of you, shall and may from time to time, and at any place or places, proceed in the execution thereof, and of every matter and thing therein contained, although the same be

not continued from time to time by adjournment.

Given at Our Court at Saint James's the twenty-sixth day of August, one thousand eight hundred and ninety-one, in the fifty-fifth year of Our Reign.

By Her Majesty's command,
HENRY MATTHEWS.

APPENDIX II.

ROYAL COMMISSION.

THE COUNCIL OF THE SOCIETY FOR THE ENCOURAGEMENT OF ARTS, MANUFACTURES, AND COMMERCE.

H.R.H. THE PRINCE OF WALES, K.G., President
of the Society of Arts.

Sir Richard Webster, G.C.M.G., Q.C., M.P., Vice-
President and Chairman of the Council of the
Society.

Sir Frederick Bramwell, Bart., D.C.L., F.R.S.,
Vice-President and Deputy-Chairman of the
Council.

H.R.H. The Duke of Saxe-Coburg and Gotha,
K.G., Vice-Pres.

Sir Frederick Abel, K.C.B., D.C.L., D.Sc., F.R.S.,
Vice-Pres.

Duke of Abercorn, K.G., Vice-Pres.

William Anderson, F.R.S., D.C.L., Treasurer.

Sir George Birdwood, K.C.I.E., C.S.I., LL.D.,
M.D., Vice-Pres.

Sir Edward Birkbeck, Bart., Vice-Pres.

Sir Edward Braddon, K.C.M.G.

George Ledgard Bristow.*

Major-Gen. Sir Owen Tudor Burne, K.C.S.I.,
C.I.E., Vice-Pres.

Alfred Carpmæl.†

Michael Carteighe, Vice-Pres.

R. Brudenell Carter, F.R.C.S., Vice-Pres.

Sir George Hayter Chubb.

Lord Alfred S. Churchill, Vice-Pres.†

B. Francis Cobb, Treasurer.

Sir Philip Cunliffe-Owen, K.C.B., K.C.M.G.,
C.I.E., Vice-Pres.†

Professor James Dewar, M.A., F.R.S., Vice-Pres.

Major-Gen. Sir J. F. D. Donnelly, K.C.B., Vice-Pres.

Sir Henry Doulton, Vice-Pres.

James Dredge.

Francis Elgar, LL.D.

Professor Clement Le Neve Foster, D.Sc., F.R.S.

Sir Douglas Galton, K.C.B., D.C.L., F.R.S.,
Vice-Pres.

Walter H. Harris.

Sir Edward James Harland, Bart., M.P., Vice-Pres.†

Lord Kelvin, F.R.S., Vice-Pres.*

Alexander B. W. Kennedy, F.R.S.‡

Sir Charles Malcolm Kennedy, K.C.B., Vice-Pres.

Sir Stuart Knill, Bart., Vice-Pres.*

Sir Frederic Leighton, Bart., P.R.A., Vice-Pres.

Sir Villiers Lister, K.C.M.G., Vice-Pres.

John Biddulph Martin, Vice-Pres.

John Fletcher Moulton, Q.C., F.R.S., M.P.

John O'Connor, Vice-Pres.

Florence O'Driscoll, M.P.*

General the Right Hon. Sir Henry F. Ponsonby,
G.C.B., Vice-Pres.

Sir Westby B. Perceval, K.C.M.G.*

Wyndham S. Portal, Vice-Pres.†

William Henry Preece, C.B., F.R.S.

Sir Robert Rawlinson, K.C.B., Vice-Pres.‡

Professor William Chandler Roberts-Austen, C.B.,
F.R.S.

Sir Owen Roberts, M.A., D.C.L., F.S.A., Vice-
Pres.

Sir Albert Kaye Rolitt, M.P., LL.D., Vice-Pres.

Sir Saul Samuel, K.C.M.G., C.B.

Right Hon. Lord Thurlow, F.R.S.‡

Secretary.—Sir Henry Trueman Wood, M.A.

Assistant Secretaries.—Henry B. Wheatley, F.S.A.,
and Edmund H. Lloyd.

Accountant.—Howard H. Room.

Honorary Solicitors.—Messrs. Wilson, Bristows and
Carpmæl, 1, Copthall-buildings, E.C.

Honorary Architect.—Col. Robert W. Edis, F.S.A.
F.R.I.B.A., 14, Fitzroy-square, W.

Honorary Auditors.—Messrs. J. O. Chadwick and
Son, 95, Finsbury-pavement, E.C.

Bankers.—Messrs. Coutts and Co., Strand, W.C.

Offices in London.—Society of Arts, John-street,
Adelphi, London, W.C.

Offices in Chicago.—Victoria-house, Jackson-park,
Chicago.

* Elected June, 1893.

† Deceased.

‡ Retired June, 1893.

APPENDIX III.

COMMITTEES.

THE NAMES OF MEMBERS OF THE ROYAL COMMISSION ARE UNDERLINED.

FINE ARTS.

- Sir Frederic Leighton, Bart., President of the Royal Academy (Chairman of the Committee).
Sir Rd. Webster, G.C.M.G., Q.C., M.P., Chairman of the Royal Commission.
 Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Deputy-Chairman of the Royal Commission.
 William Agnew.
 J. Macvicar Anderson, President of the Royal Institute of British Architects.
 Wyke Bayliss, F.S.A., President of the Royal Society of British Artists.
 Philip H. Calderon, R.A.
Sir Philip Cunliffe-Owen, K.C.B., K.C.M.G., C.I.E.
 Henry William Banks Davis, R.A.
 Sir John Gilbert, R.A., Pres. Royal Society of Painters in Water Colours.
- F. Seymour Haden, President of the Royal Society of Painter-Etchers.
 Alexander Henderson.
 Sir James D. Linton, President of the Royal Institute of Painters in Water Colours.
 W. E. Lockhart, R.S.A.
 H. Stacy Marks, R.A., Deputy-President of the Royal Society of Painters in Water Colours.
 Walter William Ouless, R.A.
 Edward J. Poynter, R.A.
 William Cuthbert Quilter, M.P.
 Frederick Stacpoole, A.R.A., Marcus Stone, R.A.
 W. Hamo Thorneycroft, R.A.
 Earl of Wharnccliffe.
 J. W. Beck, Secretary to the Committee.

COLONIES.

- Sir Saul Samuel, K.C.M.G., C.B. (Chairman of the Committee).
Sir Rd. Webster, G.C.M.G., Q.C., M.P., Chairman of the Royal Commission.
 Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Deputy-Chairman of the Royal Commission.
 Sir Rutherford Alcock, K.C.B.
 Sir Colville Barclay, Bart., C.M.G.
 Henry Coppinger Beeton.
 Sir Francis Dillon Bell, K.C.M.G., C.B.
 Sir A. N. Birch, K.C.M.G.
 Sir Edward N. C. Braddon, K.C.M.G.
 Major-General Sir Owen Tudor Burne, K.C.S.I., C.I.E.
 General Sir Andrew Clarke, G.C.M.G., C.B., C.I.E.
 Hyde Clarke.
 B. Francis Cobb.
- Sir Daniel Cooper, Bart., G.C.M.G.
 E. Cunliffe-Owen, C.M.G.
 C. Washington Eves, C.M.G.
 Sir J. F. Garrick, K.C.M.G.
 Colonel A. C. Hamilton, R.E.
 Walter H. Harris.
 General Sir William Francis Drummond Jervois, G.C.M.G., C.B., F.R.S.
Sir Chas. Malcolm Kennedy, K.C.B.
 Sir Charles Mills, K.C.M.G., C.B.
 Sir John B. Monckton.
 Admiral Sir Erasmus Ommanney, C.B., F.R.S.
 Sir Rawson W. Rawson, K.C.M.G., C.B.
 Field-Marshal Sir John Lintorn Simmons, G.C.B., G.C.M.G.
 Sir Charles Tupper, Bart., G.C.M.G., C.B.
 Sir James Youl, K.C.M.G.
 Sir Frederick Young, K.C.M.G.

INDIA.

- Major-General Sir Owen Tudor Burne, K.C.S.I., C.I.E. (Chairman of the Committee).
Sir Rd. Webster, G.C.M.G., Q.C., M.P., Chairman of the Royal Commission.
- Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Deputy-Chairman of the Royal Commission.
 Sir Frank Forbes Adam, C.I.E.
 George W. Allen, C.I.E.

INDIA—continued.

- Sir Edwin Arnold, K.C.I.E., C.S.I.
 Lionel Robert Ashburner, C.S.I.
 Baden H. Baden-Powell, C.I.E.
 M. M. Bownaggee, C.I.E.
Sir Geo. Birdwood, K.C.I.E., C.S.I., LL.D., M.D.
 David Carmichael.
 General Sir George Chesney, K.C.B., C.S.I., C.I.E.
 C. Purdon Clarke, C.I.E.
 Sir Henry Stuart Cunningham, K.C.I.E.
 Sir Juland Danvers, K.C.S.I.
 Major-General Thomas Dennehy, C.I.E.
 William Digby, C.I.E.
 Sir Joseph Fayrer, K.C.S.I., M.D., LL.D., F.R.S.
 Colonel C. J. O. Fitzgerald, C.B.
- W. S. Halsey.
 Robert Hardie.
 Sir Chas. Malcolm Kennedy, K.C.B.
 Sir Henry S. King, K.C.I.E., M.P.
 Sir William Mackinnon, Bt., C.I.E.
 Lieut.-General J. Michael, C.S.I.
 Dadabhai Naoroji, M.P.
 Sir Charles Pontifex, K.C.I.E.
 Lesley C. Probyn.
 Vincent J. Robinson, C.I.E.
 Alexander Rogers.
 Sir Richard Temple, Bart., G.C.S.I., D.C.L., M.P.
 Thomas H. Thornton, C.S.I., D.C.L.
 Stephen Wheeler.
 Sir Alexander Wilson.
 S. Digby, Hon. Secretary to the Committee.

AGRICULTURE AND FOOD PRODUCTS.

- Earl of Feversham, President of the Royal Agricultural Society (Chairman of the Committee).
Sir Rd. Webster, G.C.M.G., Q.C., M.P., Chairman of the Royal Commission.
 Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Deputy-Chairman of the Royal Commission.
 His Royal Highness, Prince Christian of Schleswig-Holstein, K.G.
 G. Mander Alexander.
William Anderson, D.C.L., F.R.S.
 Alfred Ashworth.
 Richard Bannister.
 James Bell, D.Sc., C.B., F.R.S.
 Sir Edward Birkbeck, Bart.
 J. Bowen-Jones.
 W. A. Burdett-Coutts, M.P.
 Earl Cathcart.
 W. Christie Miller.
 John Clay, Jun.
 Earl of Coventry.
 Major P. G. Craigie.
 Alfred Darby.
 Sir Maurice Fitzgerald, Bart. (Knight of Kerry.)
 Sir J. H. Gilbert, F.R.S.
 Walter Gilbey.
 John Gilmour.
 Sir George Macpherson Grant, Bart.
 Captain Heaton.
 James Hornsby.
- Charles Howard.
 Sir Robert Jardine, Bt., M.P.
 Colonel Sir Nigel Kingscote, K.C.B.
 Sir John Bennett Lawes, Bart., LL.D., F.R.S.
 Lieut.-General J. Michael, C.S.I.
 Duke of Montrose, K.T., President of the Highland and Agricultural Society of Scotland.
 Lord Moreton.
 Ralph Palmer.
 Hon. Cecil T. Parker.
 Alfred E. Pease, M.P.
 Albert Pell.
 Daniel Pidgeon.
 Duke of Portland.
 Clare Sewell Read.
 Earl of Rosse, K.P., D.C.L., F.R.S., President of the Royal Dublin Society.
 G. H. Sanday.
 Hugh C. Smith.
 Sir Mark J. Stewart, Bart., M.P.
 John Thornton.
 Sir John Thorold, Bart.
 Sir Wm. Throckmorton, Bart.
 Dr. J. Augustus Voelcker.
 Professor Robert Wallace.
 Duke of Westminster, K.G.
 Sir William Williams, Bart.
 Sir Jacob Wilson.
 Christopher W. Wilson.
 Earl of Winterton.
 Ernest Clarke, Hon. Secretary to the Committee.

MINES AND METALLURGY.

Sir Isaac Lowthian Bell, Bart., F.R.S. (Chairman of the Committee).
 Sir Rd. Webster, G.C.M.G., Q.C., M.P., Chairman of the Royal Commission.
 Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Deputy - Chairman of the Royal Commission.
 Sir Frederick Abel, K.C.B., D.C.L., D.Sc., F.R.S., President of the Iron and Steel Institute.
 Lord Aberdare, G.C.B., F.R.S.
 Emerson Bainbridge.
 Edwin J. Ball, Ph.D.
 Bennett H. Brough.
 W. S. Caine, President of the British Iron Trade Association.
 Thomas Carrington, M.Inst. C.E., F.G.S.
 John Daglish.

Prof. James Dewar, M.A., F.R.S.
 Prof. Clement Le Neve Foster D.Sc., F.R.S.
 Sir Archibald Geikie, LL.D., F.R.S., F.G.S., President British Association.
 Percy C. Gilchrist, F.R.S.
 J. G. Gordon.
 H. W. Hughes.
 Sir James Kitson, Bart.
 J. A. Longden, M.Inst.C.E.
 G. Lewis.
 Sir William T. Lewis.
 George Matthey, F.R.S.
 Prof. John Herman Merivale.
 Mansfeldt Henry Mills.
 Joseph Mitchell.
 Prof. W. C. Roberts-Austen, C.B., F.R.S.
 F. W. Rudler.
 Arthur Sopwith.
 Alexander Siemens.
 Josiah Smith.
 William Thomas.
 John Williamson.

ENGINEERING, ARCHITECTURE, &c.

Sir Frederick Bramwell, Bart., D.C.L., F.R.S., M.Inst.C.E. (Chairman of the Committee).
 Sir Rd. Webster, G.C.M.G., Q.C., M.P., Chairman of the Royal Commission.
 James Abernethy, F.R.S.E., M.Inst.C.E.
 J. Macvicar Anderson, Pres. R.I.B.A.
 William Anderson, D.C.L., F.R.S., M.Inst.C.E., Pres-Inst.M.E.
 Sir Benj. Baker, K.C.M.G., F.R.S., M.Inst.C.E.
 William Henry Barlow, F.R.S., M.Inst.C.E.
 Charles Barry, F.R.I.B.A., F.S.A.
 J. Wolfe Barry, M.Inst. C.E.
 George Berkeley, President Inst.C.E.
 Sir Benj. Chapman Browne, D.C.L., M.Inst.C.E.
 Sir George Barclay Bruce, M.Inst.C.E.
 Sir E. H. Carbutt, Bart., M.Inst.C.E.
 Henry Chapman, M.Inst.C.E.
 Sir George Hayter Chubb.
 Wm. Henry Corfield, M.A., M.D., Oxon., F.R.C.P.
 Sir James N. Douglass, F.R.S., M.Inst.C.E.
 James Dredge.
 Colonel Robert W. Edis, F.R.I.B.A., F.S.A.
 Francis Elgar, LL.D., M.Inst.C.E.
 James Forrest.
 Sir John Fowler, Bart., K.C.M.G., LL.D., M.Inst. C.E.

Sir Douglas Galton, K.C.B., D.C.L., F.R.S.
 Arthur Greenwood, M.Inst. C.E.
 Sir Charles Hutton Gregory, K.C.M.G., M.Inst.C.E.
 Sir Edward James Harland, Bart., M.P.
 Henry Gryah Harris, M.Inst.C.E.
 Charles Hawksley, M.Inst. C.E.
 Thomas Hawksley, F.R.S.
 Lieut.-Colonel W. Haywood, M.Inst.C.E.
 John Hopkinson, D.Sc., M.A., F.R.S., M.Inst.C.E.
 William H. Massey, M.Inst. C.E.
 W. H. Maw.
 Reginald E. Middleton.
 Charles Henry Moberly, M.Inst.C.E.
 Captain Andrew Noble, C.B., F.R.S., M.Inst.C.E.
 M. F. O'Reilly, D.Sc.
 Sir Charles M. Palmer, Bart., M.P.
 Sir Robert Rawlinson, K.C.B., M.Inst.C.E.
 Sir Edward James Reed, K.C.B., M.P., F.R.S., M.Inst.C.E.
 Colonel M. T. Sale, R.E., C.M.G.
 Captain Sir Eyre M. Shaw, K.C.B.
 Joseph Tomlinson, M.Inst. M.E., M.Inst.C.E.
 Captain Sir Henry W. Tyler.
 Prof. W. Cawthorne Unwin, F.R.S., M.Inst.C.E.
 Francis William Webb, M.Inst.C.E.
 Edward Woods, M.Inst.C.E.

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 Sir Rd. Webster, G.C.M.G., Q.C., M.P., Chairman of the Royal Commission.
 Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Deputy - Chairman of the Royal Commission.
 Sir Frederick Abel, K.C.B., D.C.L., D.Sc., F.R.S.
 Prof. W. Grylls Adams, M.A., D.Sc., F.R.S.
 Colonel R. T. Armstrong, C.B., R.E.
 Professor W. E. Ayrton, F.R.S.
 Major Cardew, R.E.
 J. Latimer Clarke, F.R.S.
 R. E. B. Crompton.
 William Crookes, F.R.S.
 Prof. James Dewar, M.A., F.R.S.
 Prof. James Alfred Ewing, B.Sc., F.R.S.
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 Prof. George Forbes, M.A., F.R.S.
 Prof. George Carey Foster, F.R.S.
 Matthew Gray.

Henry Graham Harris.
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 Prof. David Edward Hughes, F.R.S.
 Gisbert Kapp.
 J. C. Lamb, C.M.G.
 Sir Henry Mance, C.I.E.
 William Mather, M.P.
 W. M. Mordey.
 John Fletcher Moulton, M.A., Q.C., F.R.S., M.P.
 Hon. Charles A. Parsons.
 James Paxman.
 Prof. John Perry, D.Sc., F.R.S.
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 Alexander Siemens.
 C. E. Spagnoletti.
 James Swinburne.
 Prof. Silvanus P. Thompson, D.Sc., F.R.S.
 Prof. Joseph J. Thomson, M.A., F.R.S.
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 Major-Gen. C. E. Webber, C.B.
 James Wimshurst.

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Sir Douglas Galton, K.C.B., D.C.L., F.R.S. (Chairman of the Committee).
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 Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Deputy - Chairman of the Royal Commission.
 Sir Nathaniel Barnaby, K.C.B.
 Charles Vernon Boys, F.R.S.
 Major-Gen. Sir Owen Tudor Burne, K.C.S.I., C.I.E.
 Henry Chapman.
 B. Francis Cobb.
 James Dredge.

Francis Elgar, LL.D.
 Sir Myles Fenton.
 James Staat Forbes.
 William Forbes.
 J. F. S. Gooday.
 Sir Edward James Harland, Bart., M.P.
 Walter H. Harris.
 Charles Holmes, Pres. Inst. of British Carriage Manufacturers.
 George Norgate Hooper.
 Thomas H. Ismay.
 Colonel Sir Nigel Kingscote, K.C.B.
 Henry Lambert.
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 Sir Rd. Webster, G.C.M.G., Q.C., M.P., Chairman of the Royal Commission.
 Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Deputy-Chairman of the Royal Commission.
 William George Ainslie.
 John Anderson, Jun.
 Sir Colville Barclay, Bart., C.M.G.
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Lord Brassey, K.C.B.
 Wm. Burdett-Coutts, M.P.
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 Michael Carteighe.
 Alexander M. Chance.
 Sir George Hayter Chubb.
 Lord Alfred S. Churchill.
 W. C. K. Clowes.
 B. Francis Cobb.
 John Corbett.
 Sir Phillip Cunliffe-Owen.
 K.C.B., K.C.M.G., C.I.E.
 I. Hunter Donaldson.
 James Dredge.
 Sir David Evans, K.C.M.G. (Alderman).

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Sir Howard Grubb, F.R.S., F.R.A.S.	Rt. Hon. The Lord Mayor. J. Biddulph Martin.
Robert Hall.	Rt. Hon. A. J. Mundella, M.P.
Walter H. Harris.	Alfred Phillips.
Colonel Edward S. Hill, C.B.	Wyndham S. Portal.
Sir Chas. Malcolm Kennedy, K.C.B.	Sir John Henry Puleston.
A. Lazenby Liberty.	Lord Sudeley, F.R.S.
William Livingstone.	Julien Tripplin.
George J. S. Lock.	Hugh Watt.
	John Young.

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Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Deputy-Chairman of the Royal Commission.	Sir Geo. Birdwood, K.C.I.E., C.S.I., LL.D., M.D.
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A. Laxenby Liberty.	Lewis Foreman Day.
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	J. T. Richardson, J.P.
	Sir Owen Roberts, M.A., D.C.L., F.S.A.
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	Swire Smith.
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Robert H. Scott, M.A., F.R.S., F.R.Met.Soc.	William Woodall, M.P.
Prof. C. Stewart, President Linnean Society.	
G. J. Symons, F.R.S.	
His Highness the Duke of Teck, G.C.B., President Royal Botanic Society.	

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	Colonel Joseph Gale.
	H. P. Robinson.
	H. Seyton Scott, Secretary to the Committee.

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Sir Fredk. Bramwell, Bart., D.C.L., F.R.S., Deputy- Chairman of the Royal Commission.	B. Francis Cobb.
	John Biddulph Martin.
	Sir Owen Roberts, M.A., D.C.L.

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MEMBERS OF THE ROYAL COMMISSION.

Sir Rd. Webster, G.C.M.G., Q.C., M.P., Chairman of the Royal Commission.	Lord Alfred S. Churchill.
Sir Fredk. Bramwell, Bart., D.C.L., F.R.S., Deputy- Chairman of the Royal Commission.	B. Frances Cobb.
Sir Frederick Abel, K.C.B., D.C.L., D.Sc., F.R.S.	Sir Philip Cunliffe-Owen, K.C.B., K.C.M.G., C.I.E.
Sir Geo. Birdwood, K.C.I.E., C.S.I., M.D., LL.D.	Sir Henry Doulton.
R. Brudenell Carter, F.R.C.S.	James Dredge.
Sir George Hayter Chubb.	Sir Douglas Galton, K.C.B., D.C.L., F.R.S.
	J. Biddulph Martin.
	John O'Connor.
	Wm. Henry Preece, F.R.S.
	Sir Owen Roberts, M.A., D.C.L., F.S.A.

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H.R.H. Princess Christian of Schleswig - Holstein, President of the Committee.	Countess of Aberdeen.
Duchess of Abercorn.	Lady Henry Somerset.
Duchess of Bedford.	Lady Alfred Churchill.
Marchioness of Salisbury.	Lady Henry Grosvenor.
	Lady Agnes Burne.
	Lady Egerton of Tatton.

WOMEN'S WORK—continued.

Lady Wolverton.	Lady Amherst.	Mrs. Fawcett.	Miss Adeane.
Lady Burdett Coutts.	Lady Galton.	Mrs. Bedford Fenwick.	Miss Forsyth.
Lady Aberdare.	Lady Roberts.	Mrs. Gordon.	Miss Emily Shaw-Lefevre.
Lady Brassey.	Lady Jeune.	Mrs. A. Morrison.	Miss Webster.
Lady Knutsford.	Mrs. David Carmichael.	Mrs. Priestley.	Miss Fay Lankester, Secretary to the Committee.
		Mrs. Roberts-Austen.	

APPENDIX IV.

LOCAL COMMITTEES.

LOCAL COMMITTEE FOR IRELAND.

Offices : 39 Dame-street, Dublin.

Rt. Hon. Lord Mayor.	J. Meade.
John Beveridge.	Rt. Rev. Monsignor Molloy,
James Brenan, R.H.A.	D.Sc., D.D.
Sir Henry Cochrane, D.L.	Richard J. Moss, F.C.S.
Sir Thomas N. Deane,	J. J. O'Meara.
R.H.A.	Hon. Horace Plunkett, M.P.
E. J. Figgis.	James Talbot Power, D.L.
Sir Howard Grubb, F.R.S.	James Shanks.
J. Malcolm Inglis.	John R. Wigram, J.P.
Edmond Johnson.	Dr. E. Perceval Wright.
J. McQuaid.	Thomas Baker, Secretary to
Thomas Mayne.	the Committee.

LOCAL COMMITTEES IN ENGLAND, SCOTLAND AND WALES.

The following Chambers of Commerce acted as Local Committees in connection with the Royal Commission :—

London,	Exeter.	Pembroke,
Barnsley,	Halifax,	Sheffield,
Barrow-in-Furness,	Hull,	Southampton,
Bradford,	Keighley,	Sunderland,
Bristol,	Liverpool,	Wakefield,
Cardiff,	Leicester,	Warrington,
Dundee,	Lincoln,	Worcester.
Edinburgh,	Newcastle & Gateshead,	

The following Chambers, while unable to act as Local Committees, undertook to distribute information in their respective districts :—

Birmingham,	Greenock,	Nottingham,
Glasgow,	Leith,	North Staffordshire.

APPENDIX V.

EXECUTIVE STAFF IN LONDON & CHICAGO.

Sir Henry Trueman Wood, M.A., Secretary to the Royal Commission.	Thomas Baker,	Superintendent (Transportation).
H. B. Wheatley, F.S.A., Assistant Secretary.	H. W. Pearson,	Superintendent (Agriculture).
Edmund H. Lloyd, Assistant Secretary and General Superintendent.	George Davenport,	Chief Clerk, Society of Arts.
Howard H. Room, Accountant.	Edward F. Bird,	Accounts Clerk.
Ralph A. Harbord, Private Secretary to Sir Henry Wood.	T. G. Dundas,	Assistant Superintendent for Traffic Arrangements.
J. W. Beck, Superintendent (Fine Arts).	James Bowdidge,	Draughtsman.
E. H. Fishbourne, M.A., Superintendent (Manufactures).	Herbert J. Dack,	} Clerical Assistants.
H. D. Wilkinson, Superintendent (Machinery, &c.).	J. D. McKinlay,	
	T. J. Christie,	
	C. D. Cassidy,	
	G. H. Wheatley,	

APPENDIX VI.

COMMISSIONERS REPRESENTING BRITISH COLONIES AND DEPENDENCIES.

CANADA.—J. S. Larke, Executive Commissioner.
 NEW SOUTH WALES.—Hon. A. Renwick, F.R.C.S., M.L.C., Executive Commissioner.
 CAPE COLONY.—Ludwig Wiener, Commissioner.
 Ceylon.—Hon. J. J. Grinlinton, Special Commssnr.

BRITISH GUIANA.—J. J. Quelch, Commissioner.
 JAMAICA.—Colonel Charles J. Ward, C.M.G., Commissioner.
 TRINIDAD.—Harry Vincent, Executive Commissioner.

APPENDIX VII.

LIST OF AMERICAN EXECUTIVE.

WORLD'S COLUMBIAN COMMISSION.

<i>President</i>	Thomas W. Palmer.
<i>Vice-President</i>	Thomas M. Waller.
<i>Secretary</i>	John T. Dickinson.

WORLD'S COLUMBIAN EXPOSITION.

<i>President</i>	Harlow N. Higinbotham.
<i>Vice-President</i>	Ferdinand W. Peck.
<i>Secretary</i>	Howard O. Edmonds.
<i>Treasurer</i>	Anthony F. Seeberger.

BOARD OF LADY MANAGERS.

<i>President</i>	Mrs. Potter Palmer.
<i>Vice-President</i>	Mrs. Ralph Trautmann.
<i>Secretary</i>	Mrs. Susan Gale Cooke.

WORLD'S CONGRESS AUXILIARY.

<i>President</i>	Charles C. Bonney.
<i>Vice-President</i>	Thomas B. Bryan.
<i>Secretaries</i>	{ Benjamin Butterworth. C. E. Young.

OFFICERS OF THE WORLD'S COLUMBIAN EXPOSITION.

<i>Director-General</i>	George R. Davis.
------------------------------	------------------

Chiefs of Departments:—

<i>Agriculture, Forestry, and Live Stock</i>	W. I. Buchanan.
<i>Horticulture</i>	J. M. Samuels.
<i>Fisheries</i>	J. W. Collins.
<i>Mines and Mining</i>	Fred. J. V. Skiff.
<i>Machinery</i>	L. W. Robinson.
<i>Transportation</i>	Willard A. Smith.
<i>Manufactures</i>	James Allison.
<i>Electricity</i>	Prof. John P. Barrett.
<i>Fine Arts</i>	Halsey C. Ives.
<i>Liberal Arts</i>	Selim H. Peabody.
<i>Ethnology</i>	Prof. F. W. Putnam.
<i>Publicity and Promotion</i>	Moses P. Handy.
<i>Foreign Affairs</i>	Walker Fearn.

WORKS.

<i>Director of Works</i>	D. H. Burnham.
<i>Assistant Director of Works</i>	E. R. Graham.

COLUMBIAN GUARD.

<i>Commandant</i>	Col. Edmund Rice.
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EXECUTIVE COMMITTEE ON AWARDS.

<i>Chairman</i>	John Boyd Thacher.
<i>Deputy-Chairman</i> ..	J. W. Hoyt.

APPENDIX VIII.

SYNOPSIS OF THE CLASSIFICATION.

DEPARTMENT A.—AGRICULTURE, FOOD AND ITS ACCESSORIES, FORESTRY AND FOREST PRODUCTS—MACHINERY AND APPLIANCES.

- Group
- 1.—Cereals, Grasses, and Forage Plants.
 - 2.—Bread, Biscuits, Pastes, Starch, Gluten, &c.
 - 3.—Sugars, Syrups, Confectionery, &c.
 - 4.—Potatoes, Tubers, and other Root Crops.
 - 5.—Products of the Farm, not otherwise classed.
 - 6.—Preserved Meats and Food Preparations.
(For Fish Products as Food, see also Group 40.)
 - 7.—The Dairy and Dairy Products.
 - 8.—Tea, Coffee, Spices, Hops, and Aromatic and Vegetable Substances.
 - 9.—Animal and Vegetable Fibres.
 - 10.—Pure and Mineral Waters, Natural and Artificial.
 - 11.—Whiskeys, Cider, Liqueurs, and Alcohol.
 - 12.—Malt Liqueurs.
 - 13.—Machinery, Processes and Appliances of Fermenting, Distilling, Bottling, and Storing Beverages.
 - 14.—Farms and Farm Buildings.
 - 15.—Literature and Statistics of Agriculture.
 - 16.—Farming Tools, Implements and Machinery.
 - 17.—Miscellaneous Animal Products—Fertilizers and Fertilizing Compounds.
 - 18.—Fats, Oils, Soaps, Candles, &c.
 - 19.—Forestry, Forest Products. (Department N.)

DEPARTMENT B.—HORTICULTURE, VITICULTURE, POMOLOGY, FLORICULTURE, &c.

- Group
- 20.—Viticulture, Manufactured Products, Methods, and Appliances.
 - 21.—Pomology, Manufactured Products, Methods, and Appliances.
 - 22.—Floriculture.
 - 23.—Culinary Vegetables.
 - 24.—Seeds, Seed Raising, Testing, and Distribution.

- Group
- 25.—Arboriculture.
 - 26.—Appliances, Methods, &c.

DEPARTMENT C.—LIVE STOCK—DOMESTIC AND WILD ANIMALS.

- Group
- 27.—Horses, Asses, Mules.
 - 28.—Cattle.
 - 29.—Sheep.
 - 30.—Goats, Llama, Camels, and other Domesticated Animals.
 - 31.—Swine.
 - 32.—Dogs.
 - 33.—Cats, Ferrets, Rabbits, &c.
 - 34.—Poultry and Birds.
 - 35.—Insects and Insect Products.
 - 36.—Wild Animals.

DEPARTMENT D.—FISH, FISHERIES, FISH PRODUCTS, AND APPARATUS OF FISHING.

- Group
- 37.—Fish, and other kinds of Aquatic Life.
 - 38.—Sea Fishing and Angling.
 - 39.—Fresh-water Fishing and Angling.
 - 40.—Products of the Fisheries and their Manipulation.
(See also, in part, Groups 6 and 17.)
 - 41.—Fish Culture.

DEPARTMENT E.—MINES, MINING, AND METALLURGY.

- Group
- 42.—Minerals, Ores, Native Metals, Gems and Crystals; Geological Specimens.
 - 43.—Mineral Combustibles—Coal, Coke, Petroleum, Natural Gas, &c.
 - 44.—Building Stones, Marbles, Ornamental Stones, and Quarry Products.
 - 45.—Grinding, Abrading, and Polishing Substances.

- Group
46.—Graphite and its Products; Clays and other Fictile Materials and their direct Products; Asbestos, &c.
47.—Limestone, Cements, and Artificial Stone.
48.—Salts, Sulphur, Fertilizers, Pigments, Mineral Waters, and Miscellaneous Useful Minerals and Compounds.
49.—Metallurgy of Iron and Steel, with the Products.
50.—Aluminium and its Alloys.
51.—Copper and its Alloys—Metallurgy.
52.—Metallurgy of Tin, Tin-plate, &c.
53.—Metallurgy of Zinc, Nickel, and Cobalt.
54.—Metallurgy of Antimony and other Metals not Specifically Classed.
55.—Extraction of Gold and Silver by Milling.
56.—Extraction of Gold and Silver by Lixiviation.
57.—Extraction of Gold, Silver, and Lead by Fire.
58.—Quarrying and Working Stone.
59.—Placer, Hydraulic, and "Drift" Mining.
60.—Tools and Appliances of Underground Mining, Timbering, and Supporting.
61.—Boring and Drilling Tools and Machinery, and Apparatus for breaking out Ore and Coal.
62.—Pumps, Engines, and Apparatus used in Mining for Pumping, Draining, and Hoisting.
63.—Moving, Storing, and Delivering Ores, Coals, &c.
64.—Apparatus for Crushing and Pulverizing.
65.—Sizing Appliances.
66.—Assaying Apparatus and Fixtures.
67.—History and Literature of Mining and Metallurgy.
68.—Originals or Reproductions of Early and Notable Implements and Apparatus used in Mining and Metallurgy.

DEPARTMENT F.—MACHINERY.

- Group.
69.—Motors and Apparatus for the Generation and Transmission of Power—Hydraulic and Pneumatic Apparatus.
70.—Fire-Engines—Apparatus and Appliances for Extinguishing Fire.
71.—Machine Tools and Machines for Working Metals.
72.—Machinery for the Manufacture of Textile Fabrics and Clothing.
73.—Machines for Working Wood.
(See also Departments A. and E.)
74.—Machines and Apparatus for Type-setting, Printing, Stamping, Embossing, and for Making Books and Paper Working.
75.—Lithography, Zincography, and Colour Printing.
76.—Photo-Mechanical and other Mechanical Processes of Illustrating, &c.
77.—Miscellaneous Hand-Tools, Machines, and Apparatus used in Various Arts.
78.—Machines for Working Stone, Clay, and other Minerals.
(See also Department E.)
79.—Machinery used in the Preparation of Foods, &c.

DEPARTMENT G.—TRANSPORTATION—RAILWAYS, VESSELS, VEHICLES.

- Group.
80.—Railways, Railway Plant and Equipment.
81.—Street Car and other Short Line Systems.
82.—Miscellaneous and Special Railways.
83.—Vehicles and Methods of Transportation on Common Roads.
84.—Aerial, Pneumatic, and other forms of Transportation.
85.—Vessels, Boats—Marine, Lake, and River Transportation.
86.—Naval Warfare and Coast Defence.

DEPARTMENT H.—MANUFACTURES.

- Group
87.—Chemical and Pharmaceutical Products—Druggists' Supplies.
88.—Paints, Colours, Dyes, and Varnishes. (See also Group 48.)
89.—Typewriters, Paper, Blank Books, Stationery.
90.—Furniture of Interiors, Upholstery, and Artistic Decoration.
91.—Ceramics and Mosaics.
(For Clays and other materials, see Group 46.)
92.—Marble, Stone, and Metal Monuments, Mausoleums, Mantels, &c. Caskets, Coffins, and Undertakers' Furnishing Goods.
93.—Art Metal Work—Enamels, &c.
94.—Glass and Glassware.
95.—Stained Glass in Decoration.
96.—Carvings in various Materials.
97.—Gold and Silver Ware, Plate, &c.
98.—Jewellery and Ornaments.
99.—Horology—Watches, Clocks, &c. (See also Group 151.)
100.—Silk and Silk Fabrics.
101.—Fabrics of Jute, Ramie, and other Vegetable and Mineral Fibres.
102.—Yarns and Woven Goods of Cotton, Linen, and other Vegetable Fibres.
103.—Woven and Felted Goods of Wool, and Mixtures of Wool.
104.—Clothing and Costumes.
105.—Furs and Fur Clothing.
106.—Laces, Embroideries, Trimmings, Artificial Flowers, Fans, &c.
107.—Hair-Work, Coiffures, and Accessories of the Toilet.
108.—Travelling Equipments—Valises, Trunks, Toilet-Cases, Fancy Leather-work, Canes, Umbrellas, Parasols, &c.
109.—Rubber Goods, Caoutchouc, Gutta-Percha, Celluloid, and Zylonite.
110.—Toys and Fancy Articles.
111.—Leather and Manufactures of Leather.
112.—Scales, Weights, and Measures. (See also Group 151.)
113.—Material of War, Ordnance and Ammunition, Weapons and Apparatus of Hunting, Trapping, &c., Military and Sporting Small Arms.
114.—Lighting Apparatus and Appliances.
115.—Heating and Cooking Apparatus and Appliances.
116.—Refrigerators, Hollow Metal Ware, Tinware, Enamelled Ware.
117.—Wire Goods and Screens, Perforated Sheets, Lattice Work, Fencing, &c.
118.—Wrought-Iron and Thin-Metal Exhibits.
119.—Vaults, Safes, Hardware, Edge Tools, Cutlery.
120.—Plumbing and Sanitary Materials.
121.—Miscellaneous Articles of Manufacture not heretofore classed.

DEPARTMENT J.—ELECTRICITY AND ELECTRICAL APPLIANCES.

- Group
122.—Apparatus Illustrating the Phenomena and Laws of Electricity and Magnetism.
123.—Apparatus for Electrical Measurements.
124.—Electrical Batteries—Primary and Secondary.
125.—Machines and Appliances for Producing Electrical Currents by Mechanical Power—Dynamical Electricity.
126.—Transmission and the Regulation of the Electrical Current.
127.—Electric Motors.
128.—Application of Electric Motors.
129.—Lighting by Electricity.

Group

- 130.—Heating by Electricity.
- 131.—Electro-Metallurgy and Electro-Chemistry.
- 132.—Electric Forging, Welding, Stamping, Tempering, Brazing, &c.
- 133.—Electric Telegraph and Electric Signals.
- 134.—The Telephone and its Appliances.—Phonographs.
- 135.—Electricity in Surgery, Dentistry, and Therapeutics.
- 136.—Applications of Electricity in various ways not hereinbefore specified.
- 137.—History and Statistics of Electrical Invention.
- 138.—Progress and Development in Electrical Science and Construction, as Illustrated by Drawings and Models of various Countries.

DEPARTMENT K.—FINE ARTS—PAINTING, SCULPTURE, ARCHITECTURE, AND DECORATION.

Group

- 139.—Sculpture.
- 140.—Paintings in Oil.
- 141.—Paintings in Water Colours.
- 142.—Paintings on Ivory, on Enamel, on Metal, on Porcelain, or other wares; Fresco Painting on Walls, &c.
- 143.—Engravings and Etchings—Prints.
- 144.—Chalk, Charcoal, Pastel, and other Drawings.
- 145.—Antique and Modern Carvings; Engravings in Medallions or in Gems; Cameos, Intaglios.
- 146.—Exhibits of Private Collections.

DEPARTMENT L.—LIBERAL ARTS—EDUCATION, LITERATURE, ENGINEERING, PUBLIC WORKS, MUSIC AND THE DRAMA.

Group

- 147.—Physical Development, Training, and Condition—Hygiene.
- 148.—Instruments and Apparatus of Medicine, Surgery, and Prosthesis.
- 149.—Primary, Secondary, and Superior Education.
- 150.—Books, Libraries, Literature, Journalism.
- 151.—Instruments of Precision, Experiments, Research, and Photography. Photographs.
- 152.—Civil Engineering—Public Works, Constructive Architecture.
- 153.—Government and Law.
- 154.—Commerce, Trade, and Banking.
- 155.—Institutions and Organisations for the Increase and Diffusion of Knowledge.
- 156.—Social, Industrial, and Co-operative Associations.

Group

- 157.—Religious Organisations and Systems—Statistics and Publications.
- 158.—Music and Musical Instruments. The Theatre.

DEPARTMENT M.—ETHNOLOGY, ARCHÆOLOGY, PROGRESS OF LABOUR AND INVENTION.

Group

- 159.—Views, Plans, and Models of Prehistoric Architectural Monuments and Habitations.
- 160.—Furniture and Clothing of Aboriginal, Uncivilised, and but Partly Civilised Races.
- 161.—Implements of War and the Chase.
(See also Groups 86 and 113.)
- 162.—Tools and Implements of Industrial Operations.
- 163.—Athletic Exercises—Games.
- 164.—Objects of Spiritual Significance and Veneration, Representation of Deities, Applications of Worship.
- 165.—Historic Archæology—Objects Illustrating the Progress of Nations.
- 166.—Models and Representations of Ancient Vessels, particularly of the Period of the Discovery of America.
- 167.—Reproductions of Ancient Maps, Charts, and Apparatus of Navigation.
- 168.—Models and Representations of Ancient Buildings, Cities, or Monuments of the Historic Period anterior to the Discovery of America.
- 169.—Models and Representations of Habitations and Dwellings built since the Discovery of America.
- 170.—Originals, Copies of Models, or Graphic Representations of Notable Inventions.
- 171.—Objects illustrating generally the Progress of the Amelioration of the Conditions of Life and Labour.
- 172.—Women's Work.
- 173.—State, National and Foreign Government Exhibits.
- 174.—The North American Indian.
- 175.—Portraits, Busts, and Statues of Great Inventors and others who have contributed largely to the Progress of Civilisation and the Well-being of Man.
- 176.—Isolated and Collective Exhibits.

DEPARTMENT N.—FORESTRY AND FOREST PRODUCTS.

Group

- 19.—Forestry and Forest Products.

APPENDIX IX.

GENERAL REGULATIONS FOR FOREIGN EXHIBITORS.

Issued by the Director-General of the Exhibition.

1. The Exhibition will be held on the shore of Lake Michigan, in the City of Chicago, and will be opened on the first day of May, 1893, and closed on the 30th day of October following.

2. All governments have been invited to appoint commissions for the purpose of organising their departments of the Exhibition. The Director-General should be notified of the appointment of such foreign commissions as soon as the appointment is made.

Diagrams of the buildings and grounds will be furnished to the foreign commissions on or before January 1, 1892, indicating the localities to be occupied by each nation, subject, however, to revision and readjustment.

3. Applications for space and negotiations relative thereto must be conducted with the commission of the country where the article is produced.

4. Foreign commissions are requested to notify the Director-General not later than June 1, 1892, whether they require any increase or diminution of the space offered them, and the amount.

5. Before November 1, 1892, the foreign commissions must furnish the Director-General with approximate plans showing the manner of allotting the space assigned to them, and also with lists of their exhibitors, and other information necessary for the preparation of the official catalogue.

Products brought into the United States at the ports of Portland (Maine), Boston, New York,

Philadelphia, Baltimore, Tampa, New Orleans, San Francisco, Wilmington, Portland, Oregon, Port Townsend (Wash.), Seattle (Wash.), Tacoma (Wash.), and Chicago (Ill.), or at any other port of entry intended for display at the International Exhibition will be allowed to go forward to the Exhibition buildings, under proper supervision of customs officers, without examination at such ports of original entry, and at the close of the Exhibition will be allowed to go forward to the port from which they are to be exported. No duties will be levied upon such goods, unless entered for consumption in the United States.

6. The transportation, receiving, unpacking, and arranging of the products for exhibition will be at the expense of the exhibitor.

7. The installation of heavy articles requiring special foundations or adjustment should, by special arrangement, begin as soon as the progress of the work upon the buildings will permit. The general reception of the articles at the Exhibition buildings will commence on November 1, 1892, and no articles will be admitted after April 10, 1893.

8. Space assigned to foreign commissions, and not occupied on the 10th day of April, 1893, will revert to the Director-General for re-assignment.

9. If products are intended for competition it must be so stated by the exhibitor; if not, they will be excluded from the examination by the international jury.

10. An Official Catalogue will be published in English, French, German, and Spanish. The sale of catalogues is reserved to the World's Columbian Exposition.

The twelve departments of classification which will determine the relative location of articles in the Exhibition—except in such collective exhibits as may receive special sanction—also the arrangement of names in the catalogue, are as follows:—

- A. Agriculture, Forest Products, Forestry; Machinery and Appliances.
- B. Viticulture, Horticulture, Floriculture.
- C. Live Stock; Domestic and Wild Animals.
- D. Fish, Fisheries, Fish Products, and Apparatus for Fishing.
- E. Mines, Mining, and Metallurgy.
- F. Machinery.
- G. Transportation—Railways, Vessels, Vehicles.
- H. Manufactures.
- J. Electricity.
- K. Fine Arts—Pictorial, Plastic, and Decorative.
- L. Liberal Arts—Education, Engineering, Public Works, Architecture, Music, and the Drama.
- M. Ethnology, Archaeology, Progress of Labour and Invention, Isolated and Collective Exhibits.
- N (afterwards added). Forestry and Forest Products.

11. Foreign commissions may publish catalogues of their respective sections.

12. Exhibitors will not be charged for space.

A limited quantity of steam and water power will be supplied gratuitously. The quantity of each will be settled definitely at the time of the allotment of space. Any power required by the exhibitor in excess of that allowed will be furnished by the World's Columbian Exposition at a fixed price. Demands for such excess of power must also be settled at the time of the allotment of space.

13. Exhibitors must provide, at their own cost, all show-cases, shelving, counters, fittings, &c., which they may require, and all countershafts, with their pulleys, belting, &c., for the transmission of power from the main shafts of the building where the exhibit is located. All arrangements of articles and

decorations must be in conformity with the general plan adopted by the Director-General.

The World's Columbian Exposition will take precautions for the safe preservation of all objects in the Exhibition; but it will in no way be responsible for damage or loss of any kind, or for accidents by fire or otherwise, however originating.

14. Favourable facilities will be arranged by which exhibitors or foreign commissions may insure their own goods.

Foreign commissions may employ watchmen of their own choice to guard their goods during the hours the Exhibition is open to the public, subject to the rules and regulations of the Exposition.

15. Foreign commissions, or such agents as they may designate, shall be responsible for the receiving, unpacking, and arrangement of objects, as well as for the removal at the close of the Exposition; but no person shall be permitted to act as such agent until he can give to the Director-General written evidence of his having been approved by the proper commission.

16. Each package must be addressed "To the Commission (name of country) at the World's Columbian Exposition, Chicago, United States of America," and should have at least two labels affixed to different but not opposite sides of each case, and give the following information:—

17. (1) The country from which it comes; (2) Name of Firm of the Exhibitor; (3) Residence of the exhibitor; (4) Department to which object belongs; (5) Total number of packages sent by that exhibitor; (6) Serial number of that particular package.

18. Within each package should be a list of all objects.

19. If no authorised person is at hand to receive goods on their arrival at the Exposition buildings they will be removed, without delay, and stored at the risk and cost of whomsoever it may concern.

20. Articles that are in any way dangerous or offensive, also patent nostrums and empirical preparations, whose ingredients are concealed, will not be admitted.

21. The removal of goods on exhibition will not be permitted prior to the close of the Exhibition.

22. Sketches, drawings, photographs, or other reproductions of articles exhibited will only be allowed upon the joint assent of the exhibitor and the Director-General; but views of portions of the building may be made upon the Director-General's sanction.

23. Immediately after the close of the Exhibition exhibitors shall remove their effects, and complete such removal before January 1, 1894; goods then remaining will be removed and sold for expenses, or otherwise disposed of under the direction of the World's Columbian Exposition.

24. Each person who becomes an exhibitor thereby acknowledges and agrees to be governed by the rules and regulations established for the Government of the Exhibition.

Special regulations will be issued concerning the exhibition of fine arts, awards, the organisation of the international juries, and sales of special articles within the buildings, and on other points not touched upon in these preliminary instructions.

25. All communications concerning the Exhibition will be addressed to the Director-General, World's Columbian Exposition, Chicago, Illinois, U.S.A.

The management reserves the right to explain or amend these regulations whenever it may be deemed necessary for the interest of the Exhibition.

GEORGE R. DAVIS,

Director-General.

APPENDIX X.—REGULATIONS OF THE BRITISH SECTION.

1. The following Regulations are subject to alteration and amplification from time to time.

2. All cases containing goods for exhibition must bear special labels, which will be issued to exhibitors in due course by the Secretary of the Royal Commission.

3. Information regarding freight, duties, &c., will be issued from time to time.

4. Exhibitors' goods will be transmitted direct in bond to Chicago, where the usual Customs examination will be made. Goods for exhibition only will not be liable to duty, but on goods sold the usual rates will have to be paid. Goods can be sold in bond, at prices independent of the tariff, the duties being payable by the purchaser.

5. Provision will be made for the storage of empty cases. Exhibitors will be informed when the arrangements are complete.

6. There will be no charge for space.*

7. Exhibitors will be permitted to mark their goods with the selling prices, exclusive and inclusive of Customs duties.

8. A limited quantity of steam and water power will be supplied gratuitously. Further supplies will be provided at a fixed rate. Countershafts, pulleys, belts, &c., must be provided by the exhibitor. Application for motive power must be made on special forms, which will be supplied on demand.

9. Exhibitors will be required to place their exhibits in such positions as to contribute as much as possible to the general effect. The whole of the arrangements relating to cases, signs, notices, nature and position of offices, and all similar matters, will be subject to such instructions as may be given by the Secretary of the Royal Commission.

10. No stand, including signboard, may exceed ten feet in height without special permission.

11. In order to ensure uniformity of decoration and general good effect, no exhibitor will be allowed to put up any flags, banners, or any other kind of decoration, without permission.

12. Exhibitors may place railings round their stands, subject to approval. In every instance the railings must be within the space allotted.

13. Any exhibitor who may obtain permission to put up an office on any of the larger stands must conform to the following rules:—The office must not exceed 8 feet in height; it must be placed at the back of the stand (unless otherwise ordered); it must be painted black, and varnished, with gilt beadings.

14. No sign or name board may be placed otherwise than parallel with the main passages (*i.e.*, parallel with the frontage of the respective stands) and as near to the back of the space as possible, so as not to interfere with the vista.

15. No printed or written bills or descriptions may be displayed unless they be neat in design and suitably framed. In all cases permission must first be obtained.

16. All signs placed over show-cases or stands must be uniform in style. Gold letters must be used upon a ground either black or corresponding in colour with the show-case or stand, and the following dimensions must not be exceeded:—

The Signs may be

The Signs may be	Long		Wide	The letters not more than
	feet	feet		
The Frontage being				inches
6 feet or less	3	1' 6"		4
6 to 8 feet	4	2' 0"		4
8 to 12 „	6	2' 6"		4
12 to 20 „	9	3' 0"		4
20 to 30 „	12	3' 0"		6
30 to 50 „	14	3' 0"		6
50 feet and upwards	20	4' 0"		8

17. The lettering may either be adhesive stamped letters or permanently gilt on the ground. Cloth covered signs and common paper lettering will not be allowed.

18. No partitions may be erected between the stands without permission, nor anything put up to shut out the sight of adjoining stands unnecessarily, or to impede the general view in all directions throughout the building.

19. Each exhibitor will be required to keep his stand, machinery, and exhibits generally, properly cleaned and in good order, during the whole period of the Exhibition.

20. Exhibitors must pay all expenses of conveying, delivering, arranging, fixing, and removing their exhibits; and also the cost of erection of all fixtures, screens, and counter according to regulations. The floor must not be cut without permission.

21. Exhibitors must personally, or by representative, superintend the reception, unpacking, installation, and, after the closing of the Exhibition, removal of their cases.

22. Exhibitors' representatives and workmen must comply with all orders issued by the Secretary of the Royal Commission.

23. All cases must be unpacked immediately on arrival.

24. No exhibitor will be permitted to transfer his allotment, or to allow any other than his own duly admitted exhibits to be placed thereon.

25. All goods exhibited must be in the name of the person or firm who signed the application form.

26. All handbills, printed matter, &c., connected with exhibits and intended for gratuitous distribution, must first receive the approval and permission of the Royal Commission. Such permission may be withdrawn at any time.

27. The infringement of any of the above regulations, of any of the regulations laid down by the American authorities, or of any additional regulations made at any time by either the American authorities or the Royal Commission, will subject the exhibitor to the forfeiture of his space, and to have his goods removed from the building without any liability attaching to the American authorities or to the Royal Commission, or their representatives, in any way whatever in consequence of such removal.

28. Each exhibitor shows at his own risk in every respect, and it is a condition that he hold the Royal Commission harmless, and indemnify them against any legal proceedings arising from any injury or accident caused or occasioned by his machinery or other article exhibited by him. The above rule applies to firms in the same way as to individual exhibitors.

29. Space not occupied fourteen days previously to the opening of the Exhibition will be otherwise allotted.

30. As the above regulations are laid down solely in the interest of the general body of exhibitors, and to ensure the satisfactory working of the section, the Royal Commission trust that the exhibitors generally will cordially co-operate in carrying them into effect.

31. Any complaints should be addressed to the Secretary of the Royal Commission, to whom also exhibitors should immediately address themselves in any cases of difficulty.

HENRY TRUEMAN WOOD, *Secretary.*

* The charges proposed in the first instance were:—

Persq. ft.

For spaces not exceeding 100 sq. ft.	5 0
For spaces exceeding 100 sq. ft. and not exceeding 200 sq. ft.	4 6
For spaces exceeding 200 sq. ft. and not exceeding 300 sq. ft.	4 0
For spaces exceeding 300 sq. ft. and not exceeding 500 sq. ft.	3 6
For spaces exceeding 750 sq. ft. and upwards	3 0

Minimum charge, £5.

APPENDIX XI.
STATEMENT SHOWING RECEIPTS AND PAYMENTS.
FROM THE COMMENCEMENT (AUGUST 28TH, 1891), TO APRIL 30TH, 1894.

Dr.			Cr.		
	£	s. d.		£	s. d.
To Government Grant	60,000	0 0	By Victoria House:—		
Interest on temporary investments	233	15 4	Construction	10,802	16 1
			Interior fittings	3,442	13 3
			Office furniture	290	17 0
			Gardens	613	9 10
			Insurance	525	0 0
			Architect's charges	350	0 0
				16,024	16 2
			Less by sale of house	2,000	0 0
					14,024 16 2
			„ Fine Art Section:—		
			Salaries.....	1,766	1 1
			Insurance	4,438	18 9
			Freight	2,439	9 5
			Collection and distribution	1,830	2 8
			Decorations and fittings... ..	685	13 7
			Miscellaneous.....	182	2 5
					11,342 7 11
			„ Women's Work Section:—		
			Installation and office expenses	1,207	4 7
			Insurance	510	1 6
			Freight	396	10 6
			Sub-committees:—		
			Education	214	11 0
			Handicrafts.....	346	0 0
			Lace	240	5 0
			Literature	200	0 0
			Needlework	271	2 6
			Nursing	800	0 0
			Fine Arts	500	0 0
			Ireland	250	0 0
			Scotland	175	0 0
			Wales	67	2 0
					5,177 17 1
			„ Official exhibits:—		
			Grants for special exhibits, &c.....	562	9 7
			Freight	456	18 3
			Insurance.....	130	1 0
					1,148 8 10
			„ Salaries (not including fine arts).....	11,576	14 7
			„ Travelling	1,627	8 7
			„ Construction and Installation	3,997	16 1
			„ Decoration of Courts	2,362	14 1
			„ Motive power for machinery, plant, &c.	1,055	4 9
			„ General and office expenses	1,096	18 6
			„ Postages and telegrams	616	2 7
			„ Dublin Committee	178	19 2
			„ Stationery	792	19 8
			„ General printing (including handbook)... ..	876	17 8
			„ Catalogue	722	19 0
			„ Advertising	403	1 0
			„ Official receptions.....	1,520	11 5
			„ Payments on account of expenses of Royal Commissioners	1,050	0 0
			„ Loss on exchanges	43	19 7
					59,618 16 8
			„ Balance in hand*	614	18 8
					£60,233 15 4
					£60,233 15 4

NOTE.—The credits are in each case the net expenditure under the heading.

* This Balance is still chargeable with certain amounts for printing, the issue of medals and diplomas, &c.

Examined with the Books and Vouchers and found correct.

10th May, 1894.

J. O. CHADWICK & SON, *Chartered Accountants,*
Auditors.

APPENDIX XII.

DETAILS OF EXHIBITION EXPENDITURE.

The following tabular statement shows the expenditure of the British Section at four previous International Exhibitions, as compared with that at Chicago.

The various heads do not always precisely compare. In Paris, 1867, no separate head is given for salaries, but a heading "management," is given. The salaries and wages actually paid appear to amount to £36,039. This total is distributed over the item "management," and other heads. The charges at Philadelphia for construction purposes refer principally to the cost of erecting "St. George's House," the office and headquarters of the Section. At Paris (1878), the corresponding head includes heavy charges for the construction of annexes, &c. The similar item for Paris (1889) is made up mainly

of the charges made to the French Executive for flooring the courts, and of the cost of completing and decorating the courts. At Chicago, the two items are given separately—Victoria-house and general construction charges. At Philadelphia and Paris (1878) special grants were made for India; the Indian accounts are not included in the Financial Statement issued with the Philadelphia Report. In 1867, 1876, and 1878, the cost of printing and stationery was borne by the Stationery-office. In all cases, except at Paris, 1889, the Commissions had free postage. For Chicago this was restricted to inland postage. The amount of £22,000, set down to Paris, 1867, under office expenses, is given in the Report, as for "House and office expenses," and appears to include the cost of the head-quarters in Paris.

	Paris, 1867.	Philadelphia, 1876.	Paris, 1878.	Paris, 1889.	Chicago, 1893.
Total amount expended	£125,592	£39,981	£66,983	£29,422	£60,000
Total space occupied (Great Britain and Colonies)	sq. ft. 280,604	sq. ft. 194,381	sq. ft. 363,018	sq. ft. 232,845	sq. ft. 500,074
Salaries, wages, and allowances	£—	£14,980	£23,517	£8,644	£11,577
Management	10,904	—	—	—	—
Travelling	—	3,120	1,899	277	1,627
Fine Art Section	10,767	4,815	7,145	3,864	11,342
Offices, head-quarters, and special buildings	—	8,926	—	315	14,025
Building, construction, office rent, &c.	44,322	—	20,812	7,290	6,361
Machinery	—	1,734	6,031	967	1,055
India	—	—	—	3,700	—
Jury	11,866	2,200	—	—	—
Storage of empty cases	—	—	2,083	563	—
Office expenses, stationery, printing, postage,) and incidentals.)	22,163	2,720	3,263	3,351	4,011
Carriage of materials	7,704	1,479	2,228	—	—
Women's work	—	—	—	—	5,178
Official and loan exhibits	15,738	—	—	—	1,149
Official entertainments	—	—	—	—	1,520
Catalogue	—	—	—	—	723
Payments on account of Expenses of Royal) Commissioners	—	—	—	—	1,050

At Vienna (1873) the expenditure was £28,753, the space 169,827 square feet. No particulars as to the details of the expenditure were given in the Vienna Report.

APPENDIX XIII.

GRANTS BY FOREIGN GOVERNMENTS.

The following is a list of the Foreign Governments which took part in the Exhibition, together with the amounts attributed to them where these have been ascertained. It is doubtful whether the list is very correct as regards the figures, the amounts being in very many cases those announced before the opening of the Exhibition, which were afterwards altered. The total amount contributed by foreign countries, including, of course, the British Colonies, is set down as \$7,000,000 (£1,400,000):—

	\$	£
Argentina	100,000 ..	20,000
Austria	110,000 ..	22,000
Belgium	57,000 ..	11,400
Bolivia	30,000 ..	6,000
Brazil	600,000 ..	120,000
Bulgaria	— ..	—
Chile	— ..	—
Colombia	100,000 ..	20,000
Costa Rica	150,000 ..	30,000
Cuba	25,600 ..	5,100
Curacao (Dutch W. Indies) ..	5,000 ..	1,000
Denmark	67,000 ..	11,400
Danish West Indies	1,200 ..	250
Ecuador	125,000 ..	25,000

	\$	£
France	733,000 ..	143,000
Germany	800,000 ..	170,000
Great Britain	291,000 ..	60,000
Greece	60,000 ..	12,000
Guatemala	200,000 ..	20,000
Honduras	20,000 ..	4,000
Hayti	25,000 ..	5,000
Japan	630,000 ..	126,000
Johore	— ..	—
Korea	— ..	—
Liberia	7,000 ..	1,400
Mexico	50,000 ..	10,000
Monaco	— ..	—
Netherlands	100,000 ..	20,000
Norway	56,280 ..	11,200
Orange Free State	7,500 ..	1,500
Paraguay	100,000 ..	20,000
Persia	— ..	—
Portugal	— ..	—
Russia	46,320 ..	9,300
Siam	— ..	—
Spain	214,000 ..	43,000
Sweden	108,000 ..	21,600
Turkey	70,000 ..	14,000
Uruguay	24,000 ..	4,800
Venezuela	— ..	—

APPENDIX XIV.

VICTORIA - HOUSE.

The following description of the decoration, furniture, &c., executed for the Victoria-house by Messrs. Johnstone, Norman and Co., 67, New Bond-street, London, W., has been supplied by the firm:—

THE GRAND HALL AND STAIRCASE.

The modelled plaster ceiling of the hall is copied from one in "Plas Mawr," Conway, North Wales, built about 1550, and generally known as "Queen Elizabeth's Palace;" that over grand staircase and principal landing is taken from one at Haddon-hall. The remainder of the enriched plaster work has been designed by Col. R. W. Edis, F.S.A., from whose drawings the oak panelling, chimney-pieces, and staircase have also been executed. The furniture of carved oak is somewhat in the Italian style of the Renaissance, and has been specially designed by Mr. Owen W. Davis. A cassone, facing the entrance, is reproduced from an old Florentine example in the Royal Palace at Naples, and it is enriched with a painted frontal panel on gilt ground, in allegorical portrayal of the departure of Columbus from Spain, by F. Hamilton Jackson. The remainder of the settees, tables, and chairs are designed on similarly ancient lines, some of the carvings being copied from examples that belonged to the great Medici family, now in the Pitti Palace at Florence.

THE RECEPTION-ROOM.

The modelled plaster ceiling is reproduced from that in the banquetting-hall at Crewe-hall, the seat of Lord Crewe, and one of the finest examples of Elizabethan architecture in England. The oak panelling and ingle-nook were specially designed by Col. R. W. Edis, F.S.A.; and the carved and inlaid

furniture, designed or drawn from existing examples by Mr. Owen W. Davis, while not of a single period, represents the gatherings together of several generations, and has an affinity running throughout which brings the whole into harmony. In the many and varied pieces in this apartment, Penshurst, Haddon-hall, Hardwicke, Ham-house, Speke-hall, Knole-house, and Hampton Court are all represented, and other selections are taken from the Louvre and Cluny Museums in Paris, and our own Museum at South Kensington, all being old ideas, but in some cases adapted to more modern requirements.

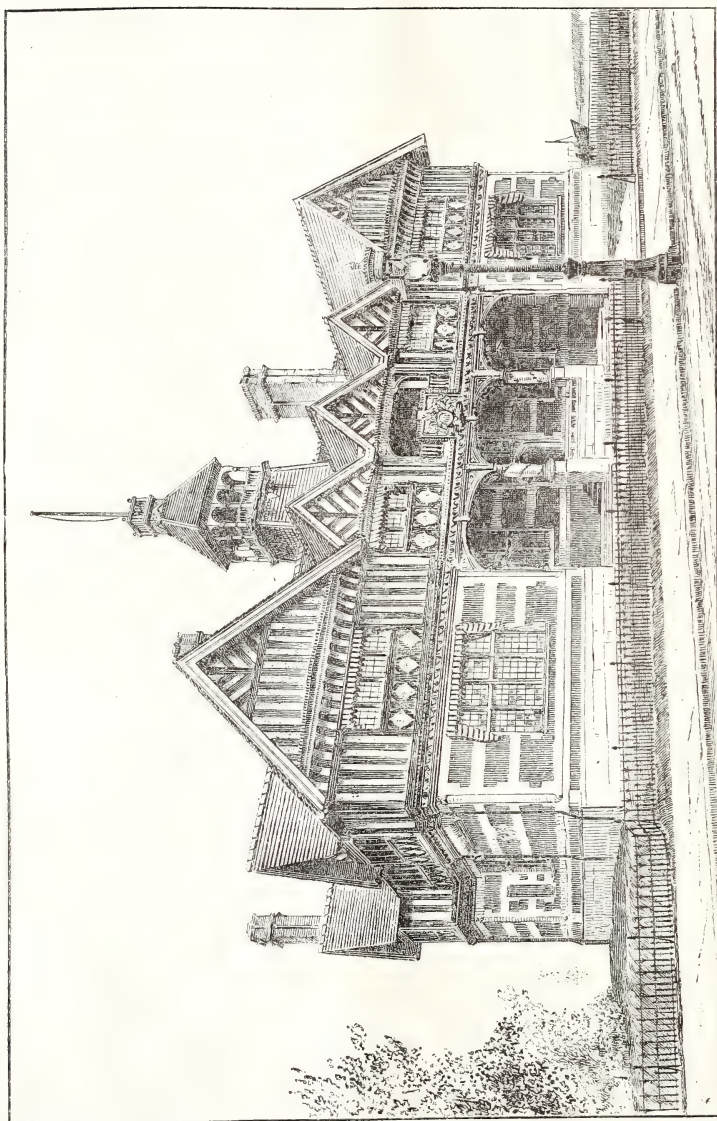
THE LIBRARY

is entirely of oak, and partakes of a more sedate character. The ribbed ceiling of geometrical form, the bookcases extending from floor to ceiling, and the panelling generally have been executed from drawings by Col. Edis; and the furniture, as in the reception-room, has either been designed or adapted from old examples by Mr. Owen W. Davis, each individual piece being, as nearly as its requirements would admit, a faithful rendering of some old master's conception.

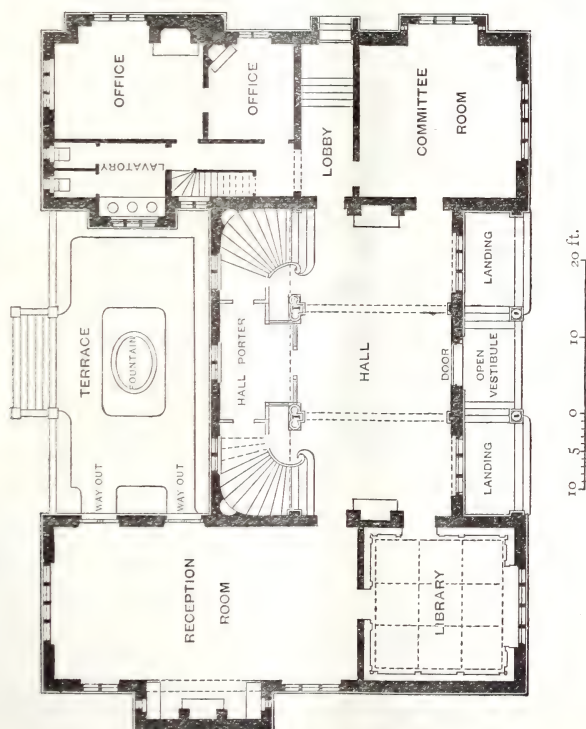
THE DINING-ROOM (OR WAITING ROOM).

The modelled plaster ceiling is reproduced from the famous one in Campden-house, Kensington; and the carved oak panelling and furniture, illustrating a simpler treatment of a modern dining-room of Elizabethan character, was designed by Mr. W. C. Codman. The embossed leather on the walls was first executed for the new ball-room at Sandringham-hall, for H.R.H. the Prince of Wales.

APPENDIX XV.
VIEW OF VICTORIA-HOUSE.



APPENDIX XV.—CONTINUED.
PLANS OF VICTORIA-HOUSE.



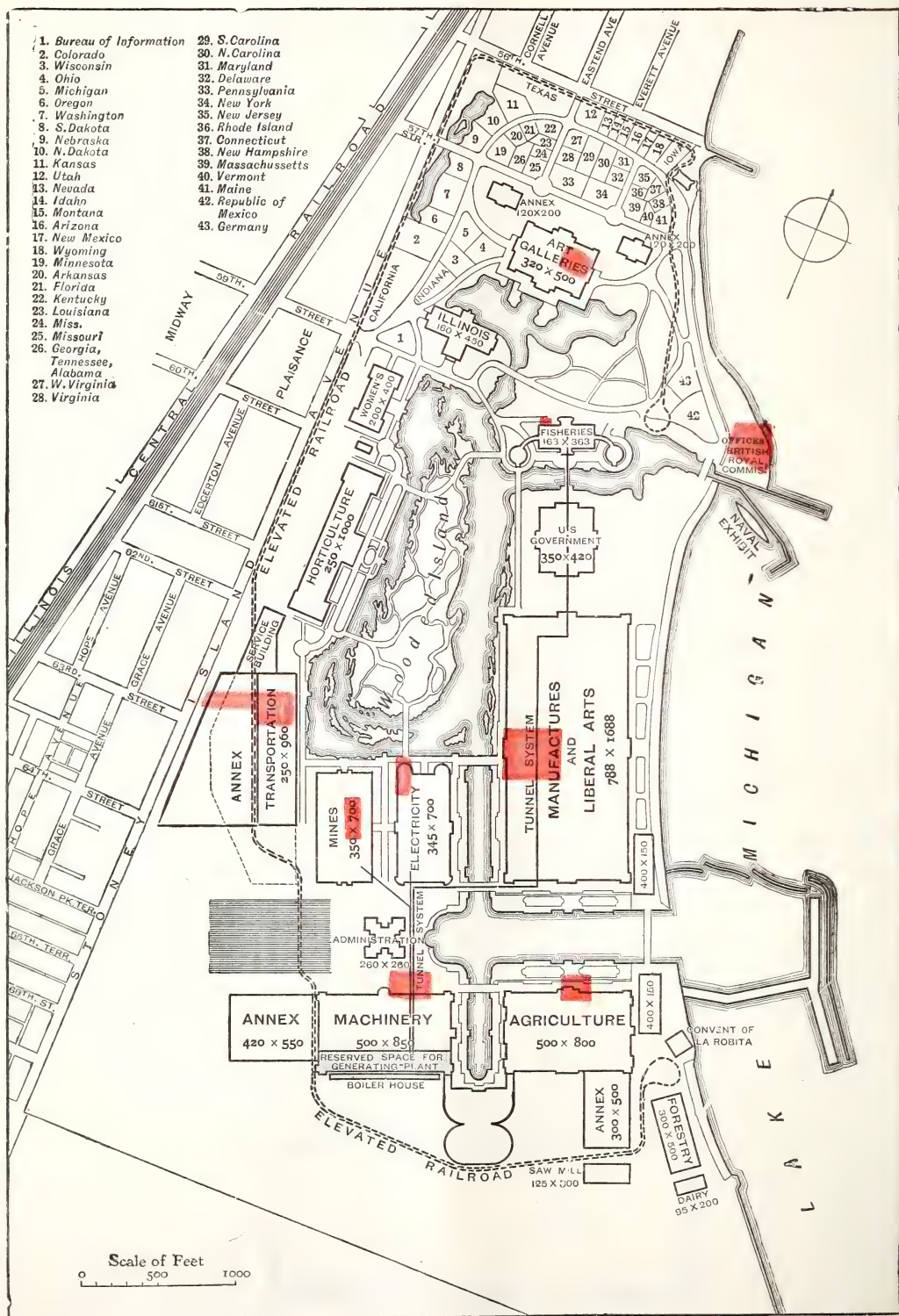
Ground Plan.



First Floor Plan.

1. Bureau of Information
2. Colorado
3. Wisconsin
4. Ohio
5. Michigan
6. Oregon
7. Washington
8. S. Dakota
9. Nebraska
10. N. Dakota
11. Kansas
12. Utah
13. Nevada
14. Idaho
15. Montana
16. Arizona
17. New Mexico
18. Wyoming
19. Minnesota
20. Arkansas
21. Florida
22. Kentucky
23. Louisiana
24. Miss.
25. Missouri
26. Georgia
27. Tennessee
28. Alabama
29. W. Virginia
30. Virginia

31. S. Carolina
32. N. Carolina
33. Maryland
34. Delaware
35. Pennsylvania
36. New York
37. New Jersey
38. Rhode Island
39. Connecticut
40. New Hampshire
41. Massachusetts
42. Vermont
43. Maine
44. Republic of Mexico
45. Germany



APPENDIX XVII.

SIZES OF THE BUILDINGS.

	Dimensions. Feet.	Area. Acres.		Dimensions. Feet.	Area. Acres.
Administration	262 by 262	1·6	Art Galleries	320 by 500	3·7
Machinery Hall	492 „ 846	9·6	Art Galleries annex (2)	120 „ 200	1·1
Machinery annex	490 „ 550	6·2	Fisheries	165 „ 365	1·4
Machinery power works	490 „ 461	2·1	Fisheries annex (2)	135 d'm	·8
Machinery pumping works ..	77 „ 84		Horticulture	250 by 998	5·7
Machine shops	106 „ 250		Horticulture green-houses (8)	24 „ 100	·5
Agriculture	500 „ 900	9·2	Anthropological	415 „ 255	3·5
Agriculture annex	300 „ 550	3·8	Casino	120 „ 250	·7
Agriculture assembly hall ..	125 „ 450	1·3	Music Hall	120 „ 250	·7
Forestry	208 „ 528	2·5	Government Building	—	3·3
Dairy	100 „ 200	·5	Battle ship	—	·3
Stock Pavilion	280 „ 440	2·8	The total area of exhibiting spaces, including galleries, was set down as just 200 acres. This did not include any of the state or foreign buildings, the Government Building, or any of the pavilions erected by individual exhibitors. This calculation also takes no note of the large area covered by buildings in the Midway Plaisance.		
Manufactures	787 „ 1687	30·5			
Mines	350 „ 700	5·6			
Electricity	345 „ 690	5·5			
Transportation	256 „ 960	5·6			
Transportation annex	425 „ 900	8·8			
Woman's	199 „ 388	1·8			

APPENDIX XVIII.

TABLE OF COLONIAL SPACE.

	Agriculture.	Forestry.	Live Stock and Dairy.	Horticulture.	Fisheries.	Mining.	Machinery.	Transportation.	Manufactures.	Liberal Arts (Gallery).	Electricity.	Fine Arts.	Ethnology.	Women's Buildings.	Special Buildings.	Total.
	sq. ft.	sq. ft.	sq. ft.	sq. ft.	sq. ft.	sq. ft.	sq. ft.	sq. ft.	sq. ft.	sq. ft.	sq. ft.	sq. ft.	sq. ft.	sq. ft.	sq. ft.	sq. ft.
Canada	16,860	3,071	575	8,500	6,940	9,602	8,140	16,667	16,192	8,998	500	2,805	1,200	—	—	100,140
New South Wales	8,693	3,098	—	5,749	1,656	8,300	1,425	1,773	5,090	6,247	—	3,870	4,666	384	—	50,951
Ceylon	1,684	—	—	—	—	—	—	—	1,350	—	—	—	—	540	24,000	27,574
Cape Colony	2,100	—	—	—	—	2,500	—	500	—	—	—	—	—	150	—	5,250
Jamaica	—	—	—	—	—	—	—	—	4,250	—	—	—	—	—	—	4,250
Trinidad	1,400	600	—	1,400	—	—	—	—	—	—	—	—	—	—	—	3,400
British Guiana	1,887	—	—	—	—	—	—	200	—	—	—	—	1,280	—	—	3,367

APPENDIX XIX.

COMPLIMENTARY LIST.

The Royal Commission are indebted to the following firms for the gift or loan of materials or articles used in the decoration and fitting up of the British Courts and of the offices of the Royal Commission:—

Anderson, Anderson, & Anderson, 37, Queen Victoria - street, London, E.C.—India-rubber mats in the Section.

Barlow & Jones, 2, Portland-street, Manchester—Towelling for use at Victoria-house.

Brown & Sons, John S., Belfast.—Table linen for use at Victoria-house.

Chubb & Sons, Lock and Safe Co., Limited, 128,

Queen Victoria-street, London, E.C.—Safes in Victoria House.

Daniell & Sons, A. B., 42-46, Wigmore-street, London, E.C.—China and glass for use in Victoria-house.

Doulton & Co., Lambeth, London, S.E.—Large group of America executed in terra-cotta in the grounds; the Doulton-ware fountain in the court-yard of Victoria-house; and the two terra-cotta panels by George Tinworth, viz., "The Prodigal Son" and "Pharaoh at the Red Sea," in the vestibule of the British Fine Art Section.

Goldsmiths' & Silversmiths' Co., 112, Regent-street, London, W.—Plate for use in Victoria-house.

Messer & Thorpe, 8, Quality-court, Chancery-lane, London, W.C.—Fire-extinguishing apparatus in Victoria-house.

Schreiber, S., 164, Fenchurch-street, London, E.C., Agent for the Chicago Rawhide Manufacturing Co.—Two belts driving two main lines of shafting running through the British Section.

Sutton & Sons, Reading.—Seeds for grounds of Victoria-house.

Tooth & Sons, Arthur, 5 and 6, Haymarket, London, S.W.—Engravings in Victoria-house.

Treloar & Sons, 68, 69, 70, Ludgate-hill, London, E.C.—Mats in the Section.

Wyckoff, Seamans & Benedict, 100, Gracechurch-street, London, E.C.; also New York and Chicago.—Remington Standard typewriters for use in Victoria-house.

Yates & Co., Limited, The Royal Carpet Factory, Wilton.—Carpets in light well.

APPENDIX XX.

LIST OF OWNERS WHO LENT WORKS OF ART.

HER MAJESTY THE QUEEN.

H.R.H. THE PRINCE OF WALES.

H.R.H. THE DUKE OF SAXE COBURG AND GOTHA.

H.R.H. THE DUCHESS OF ALBANY.

Aberdeen, Earl of.	Duckworth, Joseph, Esq.	Lawrence, Hon. C. N.	Pears, Messrs. A. and F., Limited.
Acton, F., Esq.	Dundee, Trustees of the Free Library of.	Lawson, Mrs. Cecil.	Pfungst, H., Esq.
Agnew, William, Esq.	Dunnachie, J., Esq.	Lawson, Sir Wilfrid, Bart., M.P.	Pilkington, Col. W. W.
Agnew & Sons, Thos., Messrs.	Dunthorne, Robert, Esq.	Leaheart, James, Esq.	Polson, John, Esq.
Anderson & Co., Messrs.	Eldon, Earl of.	Le Brasseur, R., Esq.	Pretymann, W., Esq.
Anderson, R. Derby, Esq.	Evans, John Carbery, Esq.	Leconfield, Right Hon. Lord.	Priestman, Edward, Esq.
Arnold, C. T., Esq.	Evans, O. Ll. J., Esq.	Leeds, Corporation of.	Pulley, Joseph, Esq.
Art Institute, Chicago.	Evans, Henry, Esq.	Lees, Elliott, Esq., M.P.	Quilter, W. Cuthbert, Esq., M.P.
Ashby, John, Esq.	Evans, Mrs. Lees.	Lefevre, H. L., Esq.	Rawlinson, Sir H., Bart., G.C.B.
Baker, William Yeats, Esq.	Eve, T. Harry, Esq.	Leicester, Corporation of.	Readhead, W. B., Esq.
Baldwin, W., Esq.	Farrar, Archdeacon, D.D.	Leigh, E. C. A., Esq.	Riddick, Robert F., Esq.
Barradale, A. W., Esq.	Farrar, Gaspard, Esq.	Leighton, Sir Frederick, Bart., P.R.A.	Roberts, J. S., Esq.
Beadle, General.	Findlay, Sir George.	Lewis, John, Esq.	Roche, Henry, Esq.
Birmingham, Corporation of.	Fine Art Society.	Lindner, M., Esq.	Romer, Sir Robert.
Blackie & Sons, Messrs.	Forbes, J. S., Esq.	Lindsay, James, jun., Esq.	Samuelson, Sir Bernhard, Bart., M.P.
Blumfeld, L., Esq.	Foster, John H., Esq.	Liverpool, Corporation of.	Scorer, F., Esq.
Boddington, Henry, Esq.	Fothergill, Theo. R., Esq.	Lockwood, William, Esq.	Smith, Sir Donald.
Bonger, Henry, Esq.	Frost & Reed, Messrs.	Lucas, Arthur, Esq.	Smith, Isaac, Esq., J.P.
Boothroyd, Alderman.	Galpin, Thomas D., Esq.	Lucas, Charles, Esq.	Smith, Eustace, Esq., M.P.
Boussod, Valadon & Co., Messrs.	Gambart, H. E., Esq.	Luxmore, C. N., Esq.	Smith, John Wm., Esq.
Brassey, Lord.	Goldsmid, Sir Julian, Bart., M.P.	Mackie, Mrs.	Spencer, Earl, K.G.
Brickwood, John, Esq.	Graphic, Proprietors of.	Maddocks, John, Esq., J.P.	Stainton, E., Esq.
Brighton, Corporation of.	Hartshorn, W. E., Esq.	Maw, Charles, Esq.	Sutherland, J. B., Esq.
Brown, D. Dyce, Esq., M.D.	Hearst, Mrs. P.	Mawson, Col. W. W.	Tooth & Sons, Messrs. Arthur
Browne, Franklin, Esq.	Hedges, David, Esq.	McCulloch, George, Esq.	Turner, H. J., Esq.
Caine, W. S., Esq., M.P.	Henderson, Alexander, Esq.	McLaren, Lord.	Ure, John, Esq.
Cairns, Countess.	Heseltine, J. P., Esq.	Miers, Mrs.	Van Ingen, E. H., Esq.
Carbutt, Sir Edward H., Bart.	Heywood, E. S., Esq., J.P.	Millais, Sir John E., Bart., R.A.	Vokins, Messrs. J. and W.
Cassell & Co., Messrs.	Hill, Arthur, Esq.	Mitchell, C., Esq.	Waechter, Max, Esq.
Castle, S. N., Esq.	Hill, H. W., Esq.	Mitchell, Tom, Esq.	Walker, J., Esq.
Cheetham, John, Esq.	Hirst, T. J., Esq.	Montagu, Samuel, Esq., M.P.	Wantage, Lord, K.C.B., V.C.
Clarke, Charles B., Esq.	Hitchcock, G., Esq.	Moore, Henry, Esq., R.A.	Waterhouse, Alfred, Esq., R.A.
Collie, Arthur Leslie, Esq.	Hoare, W. S., Esq.	Morgan, Pierpoint, Esq.	Waterlow, Sir Sydney, Bart., M.P.
Cooper, T. S., Esq., R.A.	Holder, J. C., Esq.	Muir, Andrew, Esq.	Whatford, J. H., Esq.
Cotes, Merton Russell, Esq., F.R.G.S.	Holl, Mrs. Frank.	Muspratt, S. K., Esq.	Whitehead, Henry, Esq.
Cox, E. A., Esq.	Holland, Stephen G., Esq.	Newcombe, F., Esq.	Wigzell, J. T., Esq.
Crompton, Mrs.	Ismay, Thomas H., Esq.	Newnes, George, Esq., M.P.	Woodroffe, F. H., Esq.
Crossfield, John, Esq.	Jacoby, C., Esq.	Newton, Maurice N., Esq.	Woolner, Mrs.
Croxford, William, Esq.	Jardine, David, Esq.	North, Colonel.	Wyllie, W. L., Esq., A.R.A.
De la Penha, E., Esq.	Keene, Harry, Esq.	Oldham, Corporation of.	Young, Alex., Esq.
Devitt, Mrs.	King, W. George, Esq.	Orrock, James, Esq., R.I.	
Devitt, Thomas L., Esq.	King, jun., Joseph, Esq.	Palmer, Mrs.	
Dole, James, Esq.	Laurence & Bullen, Messrs.		
Dowdeswell, Messrs.			

APPENDIX XXI.

SUPPLY OF MOTIVE POWER.

BY H. D. WILKINSON, ENGINEER TO THE BRITISH SECTION.

For operating the various machinery in the British Section, power was supplied by the shafting, by steam, by electric motors, and by compressed air. Three exhibitors of looms ran their machinery by electric motor, because by that means they could operate for as many hours as they wished daily, whereas the line shaft was only run from 8 a.m. to 5 p.m.

Except in the case of electric motors no charge was made for the supply of power when the machines using the same were not performing any work, but where anything was being driven by engines or manufactured by machines, a charge was made for the power estimated to be in use. It was impossible to measure the power absorbed by the various classes of machinery operated, but in every case I was able to negotiate a satisfactory understanding between the exhibitors and the chief of the building as to the amount of power actually used, and upon this the exhibitors agreed to pay.

Steam was charged at the rate of \$40 for six months' supply per horse-power, or at 4 cents per horse-power hour. Compressed air was supplied at \$60 per horse-power for six months, or at 5 cents per horse-power hour, and power from shafting was charged at the rate of \$50 per horse-power for six months.

Exhibitors, who chose to drive by electric motors, had to purchase their motors from the manufacturing companies, as they could not be obtained on hire. The company having fixed a motor, there was then the cost of connecting it to the mains, for which the

Exposition had a scale of charges ranging from \$20 per horse-power for a motor of $\frac{1}{2}$ horse-power or under, to \$10 per horse-power for over 10-horse-power. The current supplied was direct at 500 volts, and the scale of charges for the six months ranged from \$80 per horse-power for $\frac{1}{4}$ horse-power and less, to \$60 per horse-power for over 2 horse-power.

Gas was also used for operating gas-engines and other exhibits, and was supplied from the works of the Hyde-park Gas Company, situated outside the Exposition. The charge was made \$1.50 per 1,000 cubic feet, with a discount of 30 per cent. if paid within six days from date of bill; no charge was made for meters, but a deposit was required. A charge of \$3 was made for a permit to open ground and make connection to main, besides which there was the cost of laying branch pipe to exhibitor's space, and the connections from branch-pipe to exhibitor's machinery.

In our Section, I arranged for one pipe to be laid, sufficient to meet all demands, and divided the cost of the same between the exhibitors requiring gas supply.

Water was supplied from the Exposition Pumping Station and was charged for at the rate of 10 cents per 1,000 gallons. The water meters put in by the Department were charged to the exhibitors. The cost of fitting was as follows:—Permit for connecting to main \$3.00; permit for connecting to waste \$3.00; cost of meter \$15.00 to \$25.00; cost of branch-pipe to exhibitor's space, and cost of plumbers' work to exhibitor's apparatus.

APPENDIX XXII.

ENGINES IN THE BRITISH SECTION.

The horizontal compound-engine lent by Messrs. Galloways (Knott Mill Iron Works, Manchester), was suitable for indicating 350 horse-power at 70 revolutions per minute, with 100 lbs. boiler pressure. It had low-pressure cylinder, 30-inch bore, placed over the high-pressure cylinder, 17-inch bore, both having a stroke of 3'9". The piston rods of these two cylinders drove on to one crank-pin by means of connecting-rods, the slide block for the low-pressure cylinder working on slide recessed in the bed-plate, and that for the high-pressure cylinder on steel slide bar forming a stay between the cylinder and the framing. The engine was fitted with Galloway's latest gear, the distribution of steam being effected by short slide valves. The high-pressure cylinder was provided with multi-ported or gridiron expansion valve working on the back of the main slide. The main slide was operated by eccentric from the crank shaft, and the expansion valve by curved slotted link, with an improved motion patented in 1890, allowing the admission of steam at full pressure without the intervention of a throttle-valve, and giving a quick cut-off from any point from 0 to 66 per cent. of the

stroke of the piston. The governor was driven by gearing, and was of the improved parabolic type, giving great sensibility and steadiness of turning; it was connected directly to the rod of the expansion slide-valve, which it controls, giving admission of steam according to the load upon the engine. The crank necks are 12 inches in diameter, and the shaft carried a fly-wheel 23 feet in diameter, grooved for twelve $1\frac{1}{4}$ -inch ropes. The condenser was placed in rear of the engine, the air-pump being horizontal, worked direct by continuation of the low-pressure piston-rod.

The engines lent by Messrs. Willans and Robinson (Thames Ditton, Surrey) were Willans's Patent Central-Valve Engines, of 360 and 165 indicated horse-power respectively. They were *single-acting*, all the brasses being kept constantly in compression, or "in constant thrust" (instead of being alternately *pulled* and *pushed*, as in ordinary engines), with the object of enabling them to run with smoothness and silence at extremely high speeds; the normal speeds of the two engines shown being, for instance, 350 and 380 revolutions per minute respectively. To scientific

engineers the engine is well-known from the two series of trials carried out by its inventor, the late P. W. Willans, described in papers read by him before the Institute of Civil Engineers in London, in the discussion of which various American engineers took part. The economy figures given by those trials are still "record figures," the consumption falling as low as about 18½ lbs. per indicated horse-power per hour non-condensing, and to 12.6 and 12.8 lbs. condensing. The engines were in both cases triple expansion, with high steam-pressure (170 lbs.), but they were very small, indicating less than 40 horse-power, and running at 400 revolutions per minute. The larger engine shown had three cranks, and of the standard "I. I. I." pattern; the smaller one, with two cranks, was of "H. H." size. The single-acting "constant thrust" engine is distinctively an English exhibit, as, although known in America, it was extensively used in England (in the form of an earlier type of the Willans' engine) for several years before it was taken up there. English experience of it, in fact, extends over nearly 20 years. The one simple engine for combined dynamo and

belt-driving was of 60 indicated horse-power, at 470 revolutions per minute.

Another engine, of 300 indicated horse-power, was also shown, coupled direct to a Siemens Brothers' (English-made) two-pole dynamo, capable of giving 180 kilowatts, or 200 if required. The machine was armed to give 1,000 ampères and about 112 volts, at 350 revolutions per minute. The combined efficiency of engine and dynamo was about 85 to 86 per cent.—that is to say, that for each 100 horse-power indicated, 85 or 86 electrical horse-power is obtained at the terminals, of the dynamo and electrical losses in the latter, amounting to 14 or 15 per cent. In plant such as that shown, with compound engines, the consumption of steam per electrical horse-power per hour is about 24 lbs. non-condensing; with triple-expansion condensing engines of the same pattern, it falls to barely 15 lbs. Though exhibited by Messrs. Willans and Robinson, Limited, the makers of the engines, this plant was lent by Messrs. Siemens Brothers, Limited, of Woolwich, England, to whom it belongs.

APPENDIX XXIII.

SUPPLY OF ELECTRICITY.

By H. D. WILKINSON, DIRECTOR OF THE BRITISH SECTION.

It was by the division of the whole lighting scheme into sections, for which contracts were entered into with different nationalities, that the lighting at Paris in 1889 was such a representative display. With one or two exceptions, notably in the case of Messrs. Siemens and Halske, who had the contract for lighting the terminal station, the whole of the electrical power plant was American. Secondly, in the Electrical building, no steam was furnished or allowed, the idea being that electrical power alone was appropriate to use. This secured a grand display for the electrical transmission of power, but was fatal to a large class of exhibits of great importance. Practice in both lighting and power is now almost entirely in direct coupled engines and dynamos, and such coupled plant here exhibited could either not be run at all, or had to be run by making the dynamo a motor to turn the engine. This affected our section in three exhibits.

The general lighting of the various buildings was by arc lamps run in series on direct current circuits, but for all incandescent lamps and arc lamps required by exhibitors the supply was by high tension, alternating current with transformers.

The high-tension wires at 2,500 volts were carried through subways to the principal points in the grounds, and from transformer pits located at points along the route current at 100 volts was taken into the various buildings. The contract for the supply of this cur-

rent was in the hands of the Westinghouse Electric Company.

The charge made by the Exposition Company for the use of lamps for six months was as follows:—Per incandescent lamp of 16 candle-power \$8; per arc lamp of 2,000 candle-power \$60.

To obtain this service the exhibitor had to pay the above in advance, together with the cost of making connection, wiring and fixing lamps, viz.:—Per incandescent lamp \$3.50; per arc lamp \$3.50.

The New York Insulated Wire Company had the exclusive right of putting in all wiring for exhibitors, and instances occurred in our own and foreign sections in which exhibitors had put in their own wiring, but could not obtain current for their lamps until they had paid the above wiring charges to the Exposition.

There was great delay in the fixing of exhibitors' lamps, as the first attention had to be given by the Electrical Department to the general lighting of the grounds and buildings, this being very much in arrear. Up to the expiry of the first three months, the full amount of \$8 per lamp had to be paid in advance, and claims for rebate on the time of non-supply claimed formally afterwards, but requisitions for light after August were allowed on an advance payment of less than \$8 per lamp, according to the time for which light was actually supplied.

APPENDIX XXIV.

C A T A L O G U E .

The following list gives the authors of the introductions to the departments of the British Catalogue:—

<i>Agriculture</i>	Ernest Clark, F.S.A., Secretary of the Royal Agricultural Society.	<i>Common Road Carriages</i>	George N. Hooper.
<i>Food, &c.</i>	R. Bannister, F.C.S.	<i>Bicycles and Tricycles</i>	George Lacey Hillier.
<i>Horticulture</i>	W. Thiselton Dyer, C.M.G., F.R.S., Director of the Royal Gardens, Kew.	<i>General Manufactures</i>	Reginald H. Hooker, B.A., Assistant Secretary of the Statistical Society.
<i>Live Stock</i>	Ernest Clarke.	<i>Textiles</i>	Swire Smith.
<i>Sea Fisheries</i>	Professor E. Ray Lankester, F.R.S.	<i>Pottery</i>	Wilton P. Rix.
<i>Angling</i>	R. B. Marston, Editor of the <i>Fishing Gazette</i> .	<i>Electricity</i>	Professor W. E. Ayrton, F.R.S.
<i>Mining</i>	Professor C. Le Neve Foster, D.Sc., F.R.S., H.M. Inspector of Mines.	<i>Fine Arts</i>	J. E. Hodgson, R.A., Professor of Painting to the Royal Academy of Arts.
<i>Metallurgy</i>	Prof. W. C. Roberts-Austen, C.B., F.R.S., Chemist to the Mint.	<i>Education</i>	J. G. Fitch, M.A., H.M. Chief Inspector of Schools.
<i>Machinery</i>	H. Graham Harris, M.Inst. C.E.	<i>Music</i>	J. A. Fuller Maitland.
<i>Ships</i>	Prof. Francis Elgar, LL.D.	<i>Photography</i>	Captain W. de W. Abney, C.B., F.R.S., Assistant Director of the Science and Art Department.
<i>Railways</i>	Sir Douglas Galton, K.C.B., F.R.S.	<i>Scientific Apparatus</i>	Professor Silvanus Thompson, F.R.S.
		<i>India</i>	Samuel Digby, Secretary of the Indian Section of the Society of Arts.

APPENDIX XXV.

LIST OF BRITISH JUDGES.

AGRICULTURE.

Food.—R. Bannister, F.C.S. (Vice-President).
Adam Brown (Jamaica).
J. J. Quelch (British Guiana).
F. Shutt (Canada).
H. Vincent (Trinidad).

LIVE STOCK.

Rev. F. Vidal.
James Weir.

HORTICULTURE.

George Nicholson, A.L.S., Curator of the Royal Gardens, Kew.
C. F. Sanders.

FISHERIES.

W. S. Letten.

MINING.

Prof. C. Le Neve Foster, D.Sc., F.R.S.
Hilary Bauerman, F.G.S. (Vice-President).

MACHINERY.

Prof. W. Cawthorne Unwin, F.R.S. (Vice-President).

TRANSPORTATION.

Shipping.—Prof. Francis Elgar, LL.D. (Vice-President).
Road Carriages.—George H. Thrupp.
Ordnance.—Capt. Orde Browne, R.E.

MANUFACTURES.

Woollens.—George Thomson.
Linsens.—Thomas Hanna.
Cutlery.—John F. Atkinson, Master Cutler, Sheffield.
Leather.—John H. Angus.
Pottery.—Francis R. Jones.

LIBERAL ARTS.

Education.—Dr. O'Reilly.
Instruments of Precision.—Prof. John Milne, F.R.S.
Civil Engineering.—Urban H. Broughton.
Scientific Apparatus.—Prof. Silvanus P. Thompson, D.Sc., F.R.S.
Sanitation.—George Shaw.
Surgery and Medicine.—Ernest Hart.

ELECTRICITY.

Prof. W. E. Ayrton, F.R.S. (Vice-President).
Prof. George Forbes, M.A., F.R.S.

FINE ARTS.

Oil Paintings.—H. W. B. Davis, R.A. (President).
Val. C. Prinsep, R.A.
Water-colours.—Alfred W. Hunt, R.W.S.
Black and White.—Frank Short, R.P.E.
Architecture.—William Emerson, F.R.I.B.A.
Sculpture.—Thomas Brock, R.A.

WOMEN'S WORK.

Philanthropy.—Mrs. McCullum.
Handicrafts.—Mrs. Crawford.
Nursing and Hygiene.—Miss Kenealy.

APPENDIX XXVI.

LIST OF AWARDS IN THE BRITISH SECTION.

[A List of the Awards in order of Classification appeared in the Society of Arts Journal of April 20, 1894.]

		Group		Group		Group	
H.M. THE QUEEN.. .. .		Group 159		Benton & Johnson.. 106		British North Borneo	
Aberdare, Lady .. 103		Aston-Webb & E.		Berger, Lewis & Sons,		Co. 153	
Abney, Capt. W. de		Ingress Bell.. .. 152		Ltd. 88		British Women (Mrs.	
W. 151		Athlone Woollen		Bernard's (Mrs.) Pro-		Gordon) 147	
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Smyth & Co., Ltd. 104	Tobin, Miss E. G. .. 106	Waterhouse, Alfred 152	Woods & Son.. .. 83
Society of Friends .. 150	Tomlinson & Hay- ward 87	Waterhouse, J. W. 140	Woods, Henry .. 140
Society for Promo- tion of Employ- ment of Women.. 151		Waterlow & Sons, Ltd. 150	Woollams, Wm. & Co. 89
		" " .. 153	" " 111
		Waterlow, Ernest A. 140	Worcester Royal Porcelain Co., Ltd. 91
			Working Ladies' Guild 90
			" " 121
			" " 155
			Worsnop, C. H. .. 114
			Wostenholm & Son, Ltd. 119

Group		Group		Group		Group	
Wright, George & Co.	90	Yarrow & Co.	86	Indian Government . .	18	Pastoril Industrial Sul. Co.	17
Wright, Peter & Sons	71	Yates & Co., Ltd. . .	103	„ „	19	Pandam Estate . .	8
Wyllie, Chas. W. . .	140	York & Son	151	Indian Women's Work	103	Pathecherra Estate	8
Wyllie, W. L. . . .	140			„ „	103	Patiale, H.H. the Maharajah	120
„ „	141	Zaehnsdorf, Joseph	150	„ „	121	Pranjewundas Lalubhai and Harkisundas & Co. . . .	Eth
INDIA.				Inspector-General of Forests, Calcutta..	18	Puttareah Co. . . .	8
Group		Group		„ „	19	Rahim Khan . . .	102
Abdullah Khan . .	93	Chiranjee Lal Kannah & Co.	97	Jalpaigorie Co. . .	9	Raojee Mulla . . .	97
Abdullah, Nagina .	96	Choti Lall	102	Jodhpore, H.H. the Maharajah	103	Ravi Varmah, Tri-vandrum	155
Alyne Estate . . .	8	Chuckoo Bhud, H.H.	96	Kapurthala, H.H. the Maharajah . .	103	Scottish Assam Co. .	8
Amgoorie Estate . .	8	Conservator of Forests, Dehra . . .	18	Kewacheira Estate..	8	Scottpore Co. . . .	8
Ardeshir and Byramji	90	Conservator of Forests, Simla . . .	9	Khasiram, Pandia & Co.	97	Second Falodhi Co.	8
„ „	93	Cntch, H.H., the Rao of	97	Khurj Beharilal . . .	46	Selim Co., Terai . .	8
„ „	96	Daday Khan	103	Kirparam Homumul	103	Shakomato Co. . .	8
„ „	102	Damoder Ratansey..	Eth	„ „	103	Shoer, Marain & Co.	97
„ „	103	Darjeeling Co. . . .	8	Kousaine Co. . . .	8	Shumboonath Rug-nathdass	102
Azizuddin	97	Dass & Co.	121	Kundum Dutt . . .	96	„ „	103
Banerjee, Dr. D. N.	87	De Forrest, Lockwood	90	Kyel Estate	8	„ „	103
Baroda, H.H. the Maharajah Gaekwar of	90	Dooloogram Estate	8	Lala Sunde Lal . .	Eth	Singbulli & Murmah Co.	8
„ „	96	Durga Kishur . . .	93	Lalu Deen Dayal . .	152	Solabari & Malijan Estate	8
„ „	97	East India Co. . . .	8	Larsingah Estate . .	8	Sohon Lal & Co. . .	97
„ „	152	Ellenbarrie Estate . .	8	Long View Co. . . .	8	Soom Co.	8
„ „	157	Framjee Jewanjee . .	96	Lydfacherre Estate..	8	Sornath Bhuderdas..	Eth
Bawal Mistry . . .	93	Framjee Nowrojee..	Eth	Mahomed Bux . . .	93	South Sylhet Co. . .	8
Belgachi Co. . . .	8	Ganeshi Lall & Son	103	Matelli Co.	31	Sroom, Pether . . .	97
Bengal Co.	8	Gannu Mull	102	Mayadas	120	Sultan Mahomed . .	93
Beniprasad	103	Good Hope Co. . . .	8	Medla Estate	8	„ „	97
Bhumgara, F. P. & Co.	90	Gopichund	98	Mim Co.	8	Tambulbaree Estate	8
„ „	91	Greenwood Co. . . .	8	Moabund Co.	8	Tarrapore Co. . . .	8
„ „	93	Gulabchund	93	Moolchund Kasiram	96	Thakore Sahib Sir Jaswatsinghji Limri	1
„ „	96	Gungaram Kallanchund	100	„ „	46	„ „	4
„ „	97	Gurjung-Jhora Co. . .	8	Morarilall and Pearylall	102	„ „	9
„ „	102	Gyabarree Co. . . .	1	Murree Brewery Co.	12	„ „	Eth
„ „	103	Happy Valley Estate	8	Mysore, H.H. the Maharajah	96	Teesta Valley Co. . .	8
„ „	103	Harry & Co.	8	„ „	103	Telb Novandas Naraindass	97
Bibnath Co.	8	Harvey & Allen Mitchell	103	„ „	120	Tellery, S. J. & Co.	97
Bicrampore Estate..	8	Hathibarie Estate..	8	Mysore, State of . .	8	„ „	96
Bissewar Peshad and Sactal Prashad . .	93	Hormusji Muncherji.	Eth	„ „	100	„ „	97
Rodraj & Co. . . .	Eth	Hyderabad, H.H. the Nizam of	97	Nagervil Mission . .	103	„ „	102
Borelli Co.	8	„ „	100	Nathan Kain	46	„ „	103
Bourne & Shepherd	151	„ „	103	Nedeem Co.	8	„ „	100
Burgu Kighan . . .	93	Indian Co.	8	North Sylhet Co. . .	8	„ „	120
Bombay Burmah Trading Co.	19	Indian Government..	9	Northern Bengal Co.	8	Tezapore & Gogra Co.	8
Chakubhai Bhuderdas	Eth	„ „	18	North - Western Cachar Co. . . .	8	Thompson, H. C. . .	Eth
Chelaram Gayanchund	102			Oak's Estate	8	Ting Ling Co. . . .	8
Cheta Ram Lakwichuna	93			Ohat Estate	8	Varna & Co.	197
				Oomerjee Mowjee . .	97	Vencatachellum, P. .	Eth
				Orphanage, Fategurh	102	Vencats Swami . . .	96
						Western Cacha Co. .	8

APPENDIX XXVII.

LIST OF BRITISH CONGRESS REPRESENTATIVES.

LIST OF DELEGATES APPOINTED BY THE ROYAL COMMISSION. (Many of these Delegates were eventually unable to attend.)

Name of Congress.	Names of Delegates.
<i>Women's Progress</i> ..	Mrs. Bedford Fenwick. Mrs. Roberts-Austen. Miss Hughes. Miss De Pledge.
<i>Public Press</i>	James Dredge.
<i>Medicine</i>	Ernest Hart. Dr. H. Radcliffe Crocker. Evan Jones. C. H. W. Parkinson. Noble Smith.
<i>Commerce & Finance</i>	Walter H. Harris. J. Biddulph Martin.
<i>Music</i>	Dr. Mackenzie. Dr. Bridge.
<i>Literature</i>	Sir Edw'n Arnold, K.C.I.E., C.S.I.
<i>Education</i>	Prof. Silvanus P. Thompson, F.R.S.
<i>Engineering</i>	Sir Benj. Baker, K.C.M.G. Prof. Francis Elgar, LL.D.
<i>Art</i>	Sir Frederic Leighton, P.R.A.
<i>Photography</i>	Sir Henry Trueman Wood, M.A.

<i>Architecture</i>	Col. R. W. Edis, F.S.A. G. S. Bridgeman.
<i>Science and Philosophy</i>	
<i>Chemistry</i>	Professor James Dewar, F.R.S. Ludwig Mond, F.R.S. Dr. C. Dreyfus. E. K. Muspratt. H. J. Elwes.
<i>Electricity</i>	W. H. Preece, F.R.S. Prof. W. E. Ayrton, F.R.S. Prof. Silvanus Thompson, F.R.S. Alexander Siemens. Major Cardew, R.E.
<i>Public Health</i>	Sir Douglas Galton, K.C.B., F.R.S.
<i>Agriculture</i>	Major Craigie. Ernest Clarke.
<i>Statistics</i>	F. Hendriks. J. Biddulph Martin. A. E. Bateman. Major Craigie.
<i>Iron and Steel</i>	E. Windsor Richards. J. J. Snelus. R. A. Hadfield.
<i>Meteorology</i>	Rear-Admiral J. P. Maclear.

Mr. James Dredge, one of the Members of the Royal Commission, was appointed Honorary President of the Engineering Congress.

APPENDIX XXVIII.

REPORT OF ELECTRICAL CONGRESS.

Washington, D. C., November 6, 1893.

*The Hon. W. Q. Gresham, Secretary of State,
Washington, D. C.*

SIR,—The undersigned having been designated by you on May 12, 1893, as delegates to represent the United States in the International Electrical Congress to be held in August at Chicago, beg to submit herewith a brief report showing the definitive action of said Congress in the matter of defining and naming units of electrical measure. The consideration of this important subject was left to what was known as the "Chamber of Delegates" of the Congress, consisting of those who had been officially commissioned by their respective Governments to act as members of the said Chamber. After conference and correspondence with the leading electricians of Europe, it had been agreed that the maximum number of such delegates to be allowed to one nation should be five, and this number was allotted to the United States, Great Britain, Germany, and France. Other nations were allowed three or two, and in some instances one.

Delegates present and taking part in the discussions and action of the Chamber were as follows:—

Representing the United States.

Professor H. A. Rowland, Johns Hopkins University, Baltimore, Md.

Dr. T. C. Mendenhall, Superintendent of U.S. Coast and Geodetic Survey, and of Standard Weights and Measures, Washington, D. C.

Professor H. S. Carhart, University of Michigan, Ann Arbor, Mich.

Professor Elihu Thomson, Lynn, Mass.

Dr. E. L. Nichols, Cornell University, Ithaca, N. Y.

Representing Great Britain.

W. H. Preece, F.R.S., Engineer in Chief and Electrician, Post-office, England; President of the Institution of Electrical Engineers, London.

W. E. Ayrton, City and Guilds of London Central Institution, Exhibition-road, London.

Professor Silvanus P. Thompson, D. Sc., F.R.S., Principal of the City and Guilds Technical College, Finsbury, London.

Alex. Siemens, 12, Queen Anne's-gate, Westminster, S.W.

Representing France.

E. Mascart, Membre de l'Institut, 176, Rue de l'Université, Paris.

T. Violle, Professeur au Conservatoire des Arts et Métiers, 89, Boulevard St. Michel, Paris.

De la Touanne, Telegraph Engineer of the French Government, 13, Rue Souffiot, Paris.

Hospitalier (Edouard). Professeur à l'Ecole de Physique et de Chimie Industrielle de la Ville de Paris; Vice-President de la Société internationale des Électriciens, 6, Rue Clichy, Paris.

Dr. S. Leduc, 5, Quai Fosse, Nantes.

Representing Italy.

Comm. Galileo Ferraris, Professor of Technical Physics and Electro-technics in the R. Museo Industriale, Turin, Via Venti Settembre, 46.

Representing Germany.

H. E. Hermann von Helmholtz, Präsident der Physikalisch-technischen Reichsanstalt, Professor a. d. Universität, Berlin, Charlottenburg bei Berlin.

Dr. Budde (Emil), Berlin N. W. Klopstockstrasse, 53.

A. Schröder, Regierungsrath, Mitglied des Kaiserl. Patentamts, Berlin.

Dr. Ernst Vott, Professor an der technischen Hochschule, München, Schwanthalerstrasse, 73—3.

Dr. Otto Lummer, Mitglied der Physikalisch-technischen Reichsanstalt, Charlottenburg, Berlin.

Representing Mexico.

Augustin W. Chavez, City of Mexico.

Representing Austria.

Dr. Johann Sahulka, Technische Hochschule, Wien.

Representing Switzerland.

A. Palaz, professeur, Lausanne.

René Thury, ingénieur, Florissant, Genève.

Representing Sweden.

M. Wennman, Byrachef i Røgle Telegrafstyrelsen, Stockholm.

Representing British North America.

Ormond Higman, Electrician, Standards Branch, Inland Revenue Department, Ottawa.

His Excellency Dr. H. von Helmholtz was made honorary president of the Congress; Dr. Elisha Gray, of Chicago, was chairman of the General Congress; and Professor H. A. Rowland, of Baltimore, was president of the Chamber of Delegates.

Meetings of the Chamber continued during six days, at the end of which its members unanimously agreed in the adoption of the following resolution:—

Resolved—That the several Governments represented by the delegates of this International Congress of Electricians be, and they are hereby, recommended to formally adopt as legal units of electrical measure the following:—As a unit of resistance, the *international ohm*, which is based upon the ohm equal to 10^9 units of resistance of the C. G. S. system of electro-magnetic units, and is represented by the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14'4521 grammes in mass, of a constant cross-sectional area, and of the length of 106'3 centimetres.

As a unit of current, the *international ampère*, which is one-tenth of the unit of current of the C. G. S. system of electro-magnetic units, and which is represented sufficiently well for practical use by the unvarying current which, when passed through a

solution of nitrate of silver in water, and in accordance with accompanying specifications,* deposits silver at the rate of 0'001118 of a gramme per second.

As a unit of electro-motive force, the *international volt*, which is the electro-motive force that, steadily applied to a conductor whose resistance is one international ohm, will produce a current of one international ampère, and which is represented sufficiently well for practical use by $\frac{1000}{1+34}$ of the electro-motive force between the poles or electrodes of the voltaic cell known as Clark's cell, at a temperature of 15° C., and prepared in the manner described in the accompanying specification.*

As a unit of quantity, the *international coulomb*, which is the quantity of electricity transferred by a current of one international ampère in one second.

As a unit of capacity, the *international farad*, which is the capacity of a condenser charged to a potential of one international volt by one international coulomb of electricity.

As a unit of work, the *joule*, which is equal to 10^7 units of work in the C. G. S. system, and which is represented sufficiently well for practical use by the energy expended in one second by an international ampère in an international ohm.

As a unit of power, the *watt*, which is equal to 10^7 units of power in the C. G. S. system, and which is represented sufficiently well for practical use by the work done at the rate of one joule per second.

As the unit of induction, the *henry*, which is the induction in a circuit when the electro-motive force induced in this circuit is one international volt, while the inducing current varies at the rate of one ampère per second.

The Chamber also voted that it was not wise to adopt or recommend a standard of light at the present time.

A more complete report of the operations of the Chamber will shortly be forwarded. This brief *resumé* of its definite action in reference to the matter of units is now submitted to facilitate the prompt dissemination among representatives of foreign Governments of the important results of a Congress of whose success and fruitfulness the United States may justly be proud.

H. A. ROWLAND.

T. C. MENDENHALL.

H. S. CARHART.

ELIHU THOMSON.

E. L. NICHOLS.

* In the following specification the term silver voltameter means the arrangement of apparatus by means of which an electric current is passed through a solution of nitrate of silver in water. The silver voltameter measures the total electrical quantity which has passed during the time of the experiment, and by noting this time the time average of the current, or if the current has been kept constant, the current itself can be deduced. In employing the silver voltameter to measure currents of about one ampère, the following arrangements should be adopted:—The kathode on which the silver is to be deposited should take the form of a platinum bowl, not less than 10 centimetres in diameter, and from 4 to 5 centimetres in depth. The anode should be a plate of pure silver some 30 square centimetres in area, and 2 or 3 millimetres in thickness. This is supported horizontally in the liquid near the top of the solution by a platinum wire passed through holes in the plate at opposite corners. To prevent the disintegrated silver which is formed on the anode from falling on to the kathode, the anode should be wrapped round with pure filter paper, secured at the back with sealing wax. The liquid should consist of a neutral solution of pure silver nitrate, containing about 15 parts by weight of the nitrate to 85 parts of water. The resistance of the voltameter changes somewhat as the current passes. To prevent these changes having too great an effect on the current, some resistance besides that of the voltameter should be inserted in the circuit. The total metallic resistance of the circuit should not be less than 10 ohms.

† A committee, consisting of Messrs. Helmholtz, Ayrton, and Carhart, was appointed to prepare specifications for the Clark's cell. Their report has not yet been received.

APPENDIX XXIX.

THE SOCIETY OF ARTS.

The Society of Arts* has always been closely associated with Exhibitions both in England and abroad. Founded in 1754 for "The Encouragement of the Arts, Manufactures, and Commerce of the country," it promoted, in 1760, the first English exhibition of pictures, and held, in 1761, what appears

to have been the first Exhibition of an industrial nature held in any country, when it showed in public the machines for which its premiums had been awarded. From this grew a long series of industrial Exhibitions held by the Society in the house which the Adams built for it in the Adelphi, and from these again originated the Exhibition of 1851, and its successor of 1862.

That the 1851 Exhibition was more than a mere expansion of the Society's annual Exhibitions was due to the foresight of H.R.H. the Prince Consort, who was its president from 1843 to 1862, and whose lamented death in that year so greatly diminished both the prestige and the success of the 1862 Exhibition. Prince Albert was succeeded in the presidency, after a year's interval, by his son, H.R.H. the Prince of Wales, who still occupies the post. The importance attached by the Prince to International Exhibitions, and his interest in them, was shown by the active share he took in the two great Exhibitions of Vienna (1873) and Paris (1878), for on both occasions he was the working President of the British Commission.

* The objects of the Society are thus stated in the charter by which it was incorporated by Royal Charter in 1847, after nearly a hundred years of independent existence:—"The encouragement of the Arts, Manufactures, and Commerce of the country, by bestowing rewards for such productions, inventions, or improvements as tend to the employment of the poor, to the increase of trade, and to the riches and honour of the kingdom; and for meritorious works in the various departments of the Fine Arts; for Discoveries, Inventions, and Improvements in Agriculture, Chemistry, Mechanics, Manufactures, and other useful Arts; for the application of such natural and artificial products, whether of Home, Colonial, or Foreign growth and manufacture, as may appear likely to afford fresh objects of industry, and to increase the trade of the realm by extending the sphere of British commerce; and generally to assist in the advancement, development, and practical application of every department of science in connection with the Arts, Manufactures, and Commerce of this country."

APPENDIX XXX.

DEDICATION CEREMONIES.

Report by Mr. Alfred Carpmael.—

Society of Arts,
John-street, Adelphi,
15th November, 1892.

DEAR SIR HENRY WOOD,—I suppose it is desirable that I should report, for the information of the Royal Commissioners, the part I have taken in the recent Dedicatory Services at Chicago.

I first called on the Honorable Michael Herbert, Chargé d'Affaires at the British Legation at Washington. He informed me that he would probably represent the British Government at Chicago, and stated his desire to afford to the Royal Commissioners every assistance in his power—an assurance which he repeated on other occasions.

On my arrival at Chicago, Mr. Fearn, the official head of all foreign matters connected with the Exhibition, called upon me. Later in the day, Colonel Grover accompanied me to Mr. Fearn's office, when the latter called, with us, on Colonel Davis, the Director-General and Master of all the Ceremonies, and other official persons.

The greater part of the following day was devoted to the inspection of the Exhibition ground and buildings—a large part of our attention being naturally given to the "Victoria-house." This is a very satisfactory building, although small when compared with some of the Exhibition buildings. I suppose from 20 to 30 such buildings could be placed on the floor of the Manufactures Hall, and still leave room for streets and approaches, but, nevertheless, it compares favourably with the official buildings of other foreign countries and of the separate States, with which alone it ought to be compared. I observe

that it has been favourably commented on in the Chicago newspapers.

The ceremonies began on the evening of the 19th October, with a ball at the "Auditorium" Hotel. Mr. Martin arrived just in time, and was present at this ball, which was attended by Mr. Morton (the acting President), and numerous persons of distinction from all parts of the United States.

You are aware of the melancholy cause of the absence of Mr. Harrison, who was detained at Washington.

The ball was given by the City of Chicago. The invitations were limited to 3,000, and it was intended to be and was a grand reception given to foreign Commissioners and others connected with the "World's Fair."

On the following day there was a civil procession, but this, I think, was connected more with the Columbus celebration than with the Exhibition.

In the evening a dinner was given by the Fellowship Club. This club exists for the purpose of entertaining strangers, and performs some of the functions of our own Lord Mayor and Corporation. At this dinner about 50 members of the club were present and some 150 guests. The latter included Vice-President Morton, ex-President Hayes, the Lord Chief Justice, and some others of the Judges of the Supreme Court of the United States. Cardinal Gibbons and two other Archbishops, some of the most distinguished orators of America, the Governors of 11 or 12 different States, Mr. Lincoln, Minister of the United States to this country, and Commissioners and others representing directly or indirectly almost every, if not every, country in the world. The reception given us was most cordial.

But the great ceremony of all was that of dedi-

cating the building to the nation. This took place on Friday, the 21st October. The weather, a matter of some importance, was perfect, bright warm sunshine with blue sky without a cloud, and not even a sign of mist upon the lake. Mr. Martin, Colonel Ward (the Commissioner from Jamaica), Colonel Grover, and myself, had received an intimation that a carriage would be waiting for us at 8.45 a.m., at the point named in Michigan-avenue. We easily found our carriage, but the procession of which we were to form a part did not move till about 10 o'clock, but thenceforward we proceeded without interruption of any kind along the seven miles of Michigan Avenue (which, as you are aware, contains some of the finest residences in or near Chicago) to Washington-park, where a review of troops took place. On the conclusion of this the carriages proceeded to the Manufactures Building, where the various authorities, Commissioners, and others, were conducted to seats appropriated to them.

The building covers more than 32 acres. The whole of this great space was filled with persons who were assisting at the ceremony; their number was variously estimated from 120,000 to 160,000. Such a sight as upwards of 100,000 people assembled on one floor under one roof, had I suppose never been seen before. It quite defies description.

The making over of the buildings to the people in presence, and with the applause of such a vast multitude, had a grand and inspiring effect. When the dedication was over we were driven back to Chicago, and the spectators and others dispersed as easily as they had been got together. This result must have required great forethought and power of organisation on the part of the authorities.

On the following day I wrote to Colonel Davis, the Director-General of the Ceremonies, expressing admiration of the completeness of the arrangements, and the wonderful manner in which the Dedication services were so successfully carried out. I have since heard from Colonel Grover that Colonel Davis was pleased to receive this letter.

As to my first impression of Chicago, I would say that, like Washington of some years ago, it may be described as a city of magnificent distances. The buildings that first catch the eye are gigantic structures 17, 18, and even 22 stories high, nearly twice

as high as any that we have in London, but besides these, which are somewhat far apart, there are fine streets, with shops that display costly wares of all sorts, though at prices that are startling, and (in addition to those already mentioned on Michigan-avenue) there are in many directions, well designed, well-built residences of the highest class; also a number of first-rate hotels, which, speaking from my short experience, are no dearer than those in other parts of America.

No one can fail to be favourably impressed by the magnitude and character of the Exhibition buildings; and, with regard to the Exhibition, I am certain that it is the intention of the Chicagoans to make their "World's Fair" one that shall compare favourably with everything of the kind that has gone before, or that may come after. No trouble, no time, and no expense will be spared, and no obstacle that can be removed by human energy will be allowed in any way to interfere with the object they have in view.

I shall always have a pleasing recollection of Chicago and the Dedication ceremonies.

I know that my hosts would have liked to have seen Great Britain represented by a Commissioner or Commissioners of rank, but all that was expressed was regret that more in number of the Commissioners were not able to be present, and a hope that all of them would attend during the coming year, an invitation which is not mere words, but is intended to be taken literally.

It only remains for me to add that I found the relations between Colonel Grover and the authorities to be of the most cordial description; it was a great pleasure to be associated with him; he is an able, courteous, and I believe thoroughly efficient representative of the Royal Commission.

The only regret that I have is, that I did not know at an earlier period that Mr. Martin would be present, as I should have liked that our call on the authorities, inspection of the buildings, &c., should have been made jointly, whereas, as it happened, his engagements and mine made any such joint action impossible.

I am, dear Sir Henry Wood,

Yours truly,

ALFRED CARPMAEL.

APPENDIX XXXI.

DONATIONS TO THE COLUMBIAN MUSEUM.

The following exhibitors in the British Section of the World's Columbian Exhibition presented certain of their exhibits to the newly-formed Columbian Museum at Chicago:—

Albion Clay Co., Limited, Albion Works, Woodville, Burton-on-Trent.

Ardeshir and Byramji, 22, Oxford-street, London, W.

Arnold, P. and J., 155, Aldersgate-street, London, E.C.

Art Union of London, 112, Strand, London, W.

Ault, Wm., Swadlincote, near Burton-on-Trent, Staffordshire.

Baker, A. P., 57, Deansgate, Manchester.

Barr, Andrew, Cophthall-avenue, London.

Bartleet and Sons, William, Abbey Mills, Redditch, Worcestershire.

Bhumgara and Co., F. P., 135, London-wall, London, E.C.

Cook and Son, Thomas, Ludgate-circus, London, E.C.

Brown and Co., Limited, John, Atlas Works, Sheffield.

Buchanan, James, 62, Dale-street, Tradeston, Glasgow.

Bull, Wm., 535, King's-road, Chelsea, London.

Bushill, T. W., Brantwood, Coventry, Warwickshire.

Calvert and Co., F. C., Gibbon-street, Bradford, Manchester.

Cheesewright, Fredk. Henry, 60, Haymarket, London, S.W.
 Combe, Barboar, and Combe, Limited, Belfast.
 Cooksey and Co., 15, Bennett-street, Stamford-street, London, S.E.
 Cory Brothers and Co., Limited, Cardiff, South Wales.
 Cowham, Joseph H., H., Westminster Training College, Horseferry-road, London, W.
 Crown Preserved Coal Co., The, Limited, Cardiff.
 Curtis and Harvey, 74, Lombard-street, E.C.
 Decorative Art Journals Co., Limited, 76a, Mosley-street, Manchester.
 East Anglian Cement Company, Shepreth, Cambridgeshire.
 Francis and Co., Limited, Bridge Foot, Vauxhall, London, S.E.
 Fuller's Earth Mining Company, Limited, Woburn Sands, Buckinghamshire.
 Fuller's Earth Union, Limited, 24, Budge-row, London, E.C.
 Gibbs and Co., Limited, 79, Mark-lane, London, E.C.
 Great Northern (Ireland) Railway Company, Dublin.
 Indian Government, Revenue and Agricultural Department, Simla.
 Indian Tea Association, Calcutta.
 International Water and Sewage Purification Co., Limited, 7, Victoria-street, London, S.W.
 Irish Railway Companies, Dublin.
 Johnson, Edmond, 94, Grafton-street, Dublin.
 Johnston, W. and A. K., Edina Works, Easter-road, Edinburgh.
 Knowles, Henry, 18, New Bridge-street, Blackfriars, London, E.C.
 Lawrence, William, 5 to 7, Upper Sackville-street, Dublin.
 London and North Western Railway Co., Euston Station, London, N.W.
 Cow Moor Co., Limited, Low Moor Iron Works, near Bradford, Yorkshire.
 Lower Lansalson China Clay (Kaolin) Co., St. Austell, Cornwall.
 Maw and Co., Limited, Benthall Works, Jackfield, R.S.O., Shropshire.

Messer and Thorpe, 8, Quality-court, Chancery-lane, London, W.C.
 Midland Railway Co., Derby.
 Musselburgh Wire and Steel Works (W. N. Brunton), Musselburgh, Scotland.
 Mysore State of India.
 Oeffelein and Co., 54, Berners-street, Oxford-street, London, W.
 Ordnance Survey of Great Britain and Ireland, Southampton.
 Ormes, Upsdale, and Co., 4, Falcon-avenue, London, E.C.
 Peake, Thomas, The Fileries, Tunstall, Staffordshire.
 Robertson, Ledlie, Ferguson, and Co., Limited, The Bank Buildings, Belfast.
 Schloss, David F., 1, Knaresborough-place, Cromwell-road, London, S.W.
 Smith and Son, C., 63, Charing-cross, London, S.W.
 Sprules, Sarah, The Distillery, Wallington, Surrey.
 Tuck and Sons, Raphael, 72 and 73, Coleman-street, London, E.C.
 Turner, Wm., and John, Wigan Junction Colliery, Wigan, Lancashire.
 Usher, Richard, Bodicote, Banbury, Oxon.
 Wells, John, 508, Oxford-street, London, W.
 York and Son, 67, Lancaster-road, Notting-hill, London, W.
 The Mineralogical and Metallurgical Collections formed for the Royal Commission were also presented to the Columbian Museum.

Other important presentations of exhibits were as follows:—

Doulton and Co., "Statue of America," to the City of Chicago.
 Government of India Forestry exhibit, to the United States Department of Agriculture.
 Royal Geographical Society's exhibit, to the University of Chicago.
 Science and Art Department (one plaster cast and pedestal), to the Detroit Museum of Art School.
 Bureau of Charities, Correction, and Philanthropy, portion of the exhibit presented to the Johns Hopkins University of Baltimore.

APPENDIX XXXII.

ALIEN LABOUR LAW.

Joint Resolution of the Senate and the House of Representatives of the United States, August, 1892.

"[PUBLIC RESOLUTION—No. 30.]

"Whereas, under and in pursuance of the Act approved April 25th, Anno Domini 1890, the President of the United States has invited the Governments and citizens of foreign nations to participate in the International Exhibition authorised by the Act above recited; and

"Whereas the invitations so extended have been accepted by the several nations, and space for installing foreign exhibits has been applied for and duly apportioned, and concessions and privileges granted by the Exposition management to the citizens and subjects of foreign nations; and

"Whereas, for the purpose of securing the production upon the Exposition grounds of scenes illustrative of the architecture, dress, habits, and modes of life, occupation, industries, means of locomotion and transportation, amusements, entertainments, and so forth, of the natives of foreign countries, it has

been necessary for the World's Columbian Exposition to grant concessions and privileges to certain firms and corporations conceding the right to make such productions: Therefore,

"Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act of Congress, approved February 26th, 1885, prohibiting the importation of foreigners under contract to perform labour, and the Acts of Congress prohibiting the coming of Chinese persons into the United States, and the Acts amendatory of these Acts, shall not be so construed, nor shall anything therein operate to prevent, hinder, or in anywise restrict any foreign exhibitor, representative, or citizen of a foreign nation, or the holder who is a citizen of a foreign nation, of any concession or privilege from the World's Columbian Exposition, from bringing into the United States, under contract, such mechanics, artisans, agents, or other *employés*, natives of their respective foreign countries, as they, or any of them, may deem necessary for the purpose of making preparation for installing or conducting

any business authorised or permitted under, or by virtue of or pertaining to, any concession or privilege which may have been granted by the World's Columbian Exposition in connection with such Exposition : *Provided, however,* That no alien shall by virtue of this Act enter the United States under contract to perform labour except by express permission, naming

such alien, of the Secretary of the Treasury ; and any such alien who may remain in the United States for more than one year after the close of said Exposition shall thereafter be subject to all the processes and penalties applicable to aliens coming in violation of the alien contract labour laws aforesaid.—Approved, August 5th, 1892.”

APPENDIX XXXIII.

LIST OF BOOKS ON THE EXHIBITION.

The following list of a very few of the numerous books published in connection with the Exhibition is given as likely to be useful for future reference. These are, indeed, only a selection from the numberless guides issued, all, however, dealing with the same material. Nearly all the foreign countries contributing issued catalogues, and many of them are expected to publish reports. The British Colonial Commissioners will also present reports to their respective Governments.

Preparations were made for an elaborate history of the Exhibition, under the editorship of Mr. George Bancroft, the historian, and it is understood that full official reports will also be made. At this date, however, when the report was written,* none of them had, of course, appeared.

OFFICIAL DIRECTORY OF THE WORLD'S COLUMBIAN EXPOSITION (Illustrated.) Publishers:—W. B. Conkey Company. Chicago. 1,120 pages.

OFFICIAL CATALOGUE. Publishers: W. B. Conkey Company, Chicago.

MEMORIAL OF THE WORLD'S COLUMBIAN EXPOSITION. By the Joint Committee on Ceremonies. (Fully illustrated.) Publishers: Stone, Kastler, and Painter. Chicago. 320 pages.

FINE ART GALLERY ILLUSTRATED (Official). Publishers: G. Barrie. Philadelphia. 383 pages.

* May, 1894.

OFFICIAL GUIDE TO THE WORLD'S COLUMBIAN EXPOSITION. (Popular Souvenir Edition.) Publishers: Columbian Guide Company (J. J. Flinn.) Chicago. 301 pages.

HANDBOOK TO THE WORLD'S COLUMBIAN EXPOSITION. (Illustrated.) Publishers: Rand, McNally, and Co. Chicago. 224 pages.

A WEEK AT THE FAIR. (Illustrated.) Publishers: Rand, McNally, and Co. Chicago. 251 pages.

BEST THINGS TO BE SEEN AT THE FAIR. (Illustrated.) Publishers: Columbian Guide Company. (John J. Flinn.) Chicago. 182 pages.

STANDARD GUIDE TO CHICAGO AND THE EXPOSITION. (Illustrated.) Publishers: Standard Guide Company. Chicago. 632 pages.

OFFICIAL ALBUM OF VIEWS OF THE WORLD'S COLUMBIAN EXPOSITION. Publishers: C. D. Arnold and H. D. Higinbotham, Official Photographers. Chicago.

WORLD'S FAIR THROUGH THE CAMERA. Collection of Views from Photographers. Publishers: Woodward and Tiernor Publishing Company. St. Louis.

RAND McNALLY'S SKETCH BOOK OF WORLD'S COLUMBIAN EXPOSITION. Publishers: Rand McNally & Co., Chicago. 220 pages.

ART FOLIO OF THE WORLD'S COLUMBIAN EXPOSITION. Publishers: Rand McNally & Co. Chicago.

APPENDIX XXXIV.

LIST OF BANNERS LENT TO THE BRITISH SECTION.

The Corporations of the following cities and boroughs kindly lent banners for the decoration of the British Courts:—

Aberdeen	Darlington	Hull
Ayr	Dartmouth	Ipswich
Banbury	Derby	Kidderminster
Barrow-in-Furness	Devonport	Kilmarnock
Bath	Dewsbury	Lancaster
Bedford	Dover	Leamington
Belfast	Dublin	Leeds
Birmingham	Dumfries	Leith
Bournemouth	Edinburgh	Lincoln
Brighton	Exeter	London
Cambridge	Glasgow	Londonderry
Canterbury	Gloucester	Lyme Regis
Cardiff	Godalming	Manchester
Chichester	Gravesend	Middlesbrough
Colchester	Greenock	Neath
Cork	Guildford	Newcastle-on-Tyne
Coventry	Haltax	Nottingham
Croydon	Huddersfield	

Oswestry	St. Helen's	Walsall
Oxford	Sheffield	West Ham
Paisley	Shrewsbury	West Hartlepool
Penzance	Southampton	Wigan
Perth	Southport	Wisbech
Peterborough	Stamford	Wolverhampton
Plymouth	Stockport	Worcester
Portsmouth	Swansea	York

The following Companies of the City of London kindly lent banners for the decoration of the British Courts:—

Butchers	Joiners	Skinner's
Carpenters	Leathersellers	Stationers
Clothworkers	Mercers	Tylers and Bricklayers
Cordwainers	Pewterers	Vintners
Curriers	Playing Card	Wax Chandlers
Farriers	Makers	Weavers
Goldsmiths	Salters	

General Notes.

BUCHAREST EXHIBITION.—Information has been received from the Foreign Office (through the Science and Art Department) respecting the fourth Exhibition of the Roumanian Co-operative Societies to be held at Bucharest from August 26 to November 12. Her Majesty's Chargé d'Affaires at Bucharest writes to the Secretary of State for Foreign Affairs that the exhibition will be placed under the patronage of the Prince and Princess of Roumania, and that the King has announced his intention of exhibiting agricultural and industrial products from the royal and personal domains. A space will be set apart for an international section in which will be exhibited foreign products of arts, industry, agriculture, forests, and mines. Medals will be awarded to foreign exhibits in each section. Applications should be made to Monsieur Bontcoulescou (president), No. 11 bis, Strada Clementza, Bucuresti, Royaume de Roumanie.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock :—

MAY 23.—“Liquid Fuels.” By G. STOCKFLETH. SIR EDWARD J. REED, K.C.B., M.P., will preside.

FOREIGN AND COLONIAL SECTION.

FRIDAY, MAY 25, AT 8 P.M.—“New South Wales.” By J. INGLIS, M.L.A.

TUESDAY, MAY 29, AT 8 P.M.—“Black and White in Afrikanderland.” By W. A. WILLS.

APPLIED ART SECTION.

Tuesday Evening, at Eight o'clock :—

MAY 22.—“Decorative Art in connection with Elementary Education.” By SELWYN IMAGE, M.A.

INDIAN SECTION.

THURSDAY, MAY 24, AT 4.30 P.M.—“The Commerce of Siam in Relation to the Trade of the British Empire.” By C. S. LECKIE, of Bangkok. SIR ALEXANDER WILSON, formerly President of the Bengal Chamber of Commerce, will preside.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 21...Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. W. Gowland, “A Bye-Product Obtained in Liquidating Copper with Lead.” 2. Mr. Oscar Guttman, “The Manufacture of Smokeless Powder.”

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. T. W. Huskinson, “A Theory concerning the Primary Cause of the Depression in Trade and Agriculture.”

Cleveland Institute of Engineers, Middlesbrough, 7½ p.m.

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mr. J. Theodore Bent, “Journey in the Hadramaut, Southern Arabia.”

Medical, 11, Chandos-street, W., 8½ p.m. Annual Oration.

TUESDAY, MAY 22...SOCIETY OF ARTS, John-street, Adelphi, London, W.C., 8 p.m. (Applied Art Section) Mr. Selwyn Image, “Decorative Art in Connection with Elementary Education.”

Royal Institution, Albemarle-street, W., 3 p.m. Rev. W. H. Dallinger, “The Modern Microscope as an Instrument of Recreation and Research.”

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. Andrew Brown, “Recent Types of Ferry Steamers.” 2. Mr. Charles Jones, “The Birkenhead Ferry-boats, *Wirral and Mersey*.”

Statistical, Geological Museum, Jermyn-street, S.W., 7½ p.m. Dr. John Macdonell, “Statistics of Litigation in England and Wales since 1859.”

Photographic, 50, Great Russell-street, W.C., 8 p.m. Mr. Henri Calmels, “Tone Etching on Copper.”

WEDNESDAY, MAY 23...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. G. Stockfleth, “Liquid Fuels.”

Geological, Burlington-house, W., 8 p.m.

Royal Society of Literature, 20, Hanover-square, W., 8 p.m.

THURSDAY, MAY 24...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Mr. C. S. Leckie, “The Commerce of Siam in Relation to the Trade of the British Empire.”

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 3 p.m. Annual Meeting.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. W. M. Flinders Petrie, “Egyptian Decorative Art.”

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Mr. R. E. Crompton, “Cost of Electrical Energy.”

Historical, 20, Hanover-square, W., 8½ p.m. Mr. A. G. Little, “The Educational Organisation of the Mendicant Friars in England.”

FRIDAY, MAY 25...SOCIETY OF ARTS, 8 p.m. (Foreign and Colonial Section). Mr. J. Inglis, “New South Wales.”

United Service Institution, Whitehall-yard, 3 p.m. Col. G. F. R. Henderson, “Lessons from the Past for the Future.”

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Sir Howard Grubb, “The Development of the Astronomical Telescope.”

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Science Schools, South Kensington, S.W., 5 p.m.

SATURDAY, MAY 26...Zoological, Regent's-park, N.W., 4 p.m. Mr. F. E. Beddard, “Sketches in Geographical Distribution.” (Lecture II.)

Botanic, Inner Circle, Regent's-park, N.W., 3½ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. R. W. Lowe, “The Stage and Society.”

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FRIDAY, MAY 25, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CONVERSAZIONE.

The Society's *conversazione* will take place at the Imperial Institute, South Kensington (by permission of the Council of the Institute), on Friday evening, June 22, from 9 to 12 p.m.

The reception will be held from 9 to 10 p.m., in the vestibule, by Sir Richard Webster, G.C.M.G., Q.C., M.P., Chairman; Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Deputy-Chairman, and the members of the Council of the Society.

Each member will receive a card for himself, which will not be transferable, and a card for a lady. A limited number of tickets will be sold to members of the Society, for the use of their friends, at a charge of five shillings each, if purchased before Saturday, 16th June.

Further particulars as to the arrangements will be given in future numbers of the *Journal*.

PRIZE FOR DESIGN FOR A SILVER CUP.

The Council of the Society are prepared to award a prize of £25 for the best design for a silver cup. The design, if adopted, will be used for the Swiney prize, which, under the will of the late Dr. Swiney, is awarded every five years by the Society for "The best published work on Jurisprudence." The value of the cup is £100. The offer is open to all students of schools of art in the United Kingdom. Competing designs should be sent in not later than the 31st December, 1894, addressed to The Secretary, Society of Arts, Adelphi, London. They may be sent in under a motto, or in the competitor's name, as preferred. Any design for which the prize of

£25 may be awarded will become the property of the Society, to be used as the Council of the Society may direct. The Council reserves the right of withholding the prize, or of awarding a smaller amount, if it should see fit.

DRAWING SOCIETY'S COM-PETITION, 1894.

The following are the names of the scholars to whom have been awarded the twelve medals placed at the disposal of the Drawing Society by the Council of the Society of Arts:—

- Anderson, R. S., Crescent-house, Bedford.—For a drawing of a lion's head from a cast.
- Beale, R. J., Mathematical School, Rochester.—For pen and ink sketches.
- Brailsford, B., High School, Blackheath.—For a science drawing.
- Bramwell, M., Ladies' College, Cheltenham.—For sepia drawing from cast of a lily.
- Casse, P., Mathematical School, Rochester.—For a design for books.
- Eaves, J., High School, Exeter.—For a drawing of a growing plant.
- Flamstead, E., High School, Nottingham.—For a drawing of a growing plant.
- Green, G. C., Grammar School, Wymondham.—For landscape sketches.
- Thompson, C. W., Mathematical School, Rochester.—For plans and elevations from own measurement.
- Thornton, L., High School, Liverpool.—For a drawing of a head from life.
- Whittington, E., Royal Grammar School, Sheffield.—For science drawings.
- Woodcock, E., High School, Dulwich.—For sketches from a cast.

Proceedings of the Society.

TWENTY-SECOND ORDINARY MEETING.

Wednesday, May 23, 1894; BOVERTON REDWOOD, F.C.S., in the chair.

The following candidates were proposed for election as members of the Society:—

- Bankes-Price, William Hughes, H.B.M.'s Vice-Consul, Chicago, Ill., U.S.A.
- Dixon, Arthur, 26, Berkeley-square, W.
- Hanson, Charles A., 49, Holland-park-road, W.
- Heaton, Aldam, 29, Bloomsbury-square, W.C.
- Paul, Matthew, Junr., Levenford Works, Dumbarton, and Alcluth, Dumbarton.
- Wall, Thomas, 113, Jermyn-street, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Craster, Major-General George Ayton, United Service Club, Pall Mall, S.W.
 Field, John W., Gas Light and Coke Company, Horseferry-road, Westminster, S.W.
 Holland, Honourable Lionel, 58, Conduit-street, W.
 Le Mesurier, Lieut.-Colonel Thomas Augustus, 2, Gloucester-walk, Kensington, W.
 Mills, William Frederick, 24, Soho-square, W.
 Wasey, George Kindersley, West of India Portuguese Guaranteed Railway Company, Morumgão, Goa, India,

The CHAIRMAN, after expressing his regret at the unavoidable absence of Sir Edward Reed, who had been announced to preside, said his only justification for occupying the position was that this subject of liquid fuel had come before him from time to time for many years, and he had taken a deep interest in it. In 1868, a most valuable paper on liquid fuel was read in that room by Dr. Benjamin H. Paul, and he must admit that, in this country, very little progress had been made since that time, in the practical application of that fuel. In other countries, notably in Russia, a great deal had been done in that direction; and since Mr. Nobel, twenty years ago, commenced the development of the Russian petroleum industry, there had been an enormous development in the use of liquid fuel in Russia, not only in steam-raising, but for metallurgical and other purposes. In referring to this subject in 1886, he was able to say that he had found that the whole of the steamers on the Caspian Sea, and a large proportion of the locomotives on the Southern Russian railroads, were driven by means of the petroleum residue called *astatki*. That successful application of liquid fuel was chiefly due to the action of Mr. Urquhart, locomotive superintendent of the Grazi-Tsaritzin railways. Mr. Stockfleth had long occupied the position of engineering expert in the Nobel Petroleum Production Company, and being, therefore, thoroughly acquainted with the subject, would no doubt be able to give most valuable information.

The paper read was—

LIQUID FUEL.

BY G. STOCKFLETH.

During last year's coal strike the question of using liquid fuel as a substitute for coal for generating steam was much discussed, and has since been in more than one sense a burning question. A few words on the subject may therefore be of interest.

The use of liquid fuel is by no means of recent date, it has for many years been pretty general in Russia, and the question cannot any more be considered as a problem which has to pass through its experimental stages. Before going further into the subject, it may be well to define which liquids can best be used

as fuel. A good many oils might enter the list were it not for some indispensable requirements such as cheapness, absence of danger, capability for developing heat and undergoing complete combustion, without producing unpleasant smells, smoke, and dangerous and unhealthy gases, which conditions practically reduce the number to the oils derived from coal and from crude petroleum. The first named (oil derived from coal) is, however, not produced in sufficient quantities for even a limited consumption, and would be far too expensive to manufacture solely for fuel purposes. It is, therefore, to crude petroleum that we must turn for obtaining a suitable oil.

Crude petroleum consists almost entirely of a mixture of a great number of hydro-carbons differing in boiling point and density, and, by being submitted to distillation, it gives a series of hydro-carbons known as gasoline, benzoline, kerosene, &c. It is not necessary here to give a detailed description of these different products, suffice it to say, that the first distillate of crude petroleum, which evaporates at a low temperature, is the most inflammable, and gradually, as the temperature is raised, the less dangerous oils are distilled, until the temperature in the stills reaches 300° C. to 320° C.; at this point the distillate is called kerosene, and the residue (which in Russian is called *astatki*) forms the oil which so admirably answers the conditions for a good liquid fuel. It contains all the heavy hydro-carbons capable of creating heat, and the high temperature to which it has been exposed having freed it from all dangerous volatile liquids, guarantees its complete safety; a match or any other naked light is immediately extinguished when plunged into it. In order to make it burn it requires special treatment, about which more shall be said presently. As *astatki* presents no danger whatever, it is in Baku stored in large open excavations in the ground, containing up to 5,000,000 poods each, equal to more than 100,000 tons. In some of the distilleries *astatki* is used as fuel under one still immediately after having been let out of another, which shows that even at a high temperature it can be handled with safety. The Russian crude petroleum gives about 35 per cent. benzoline, gasoline, and kerosene, the remaining 65 per cent. is used for the manufacture of lubricating oils and mostly as fuel. To give an idea of the extent to which it is used in Russia for locomotive, steamship, and even stationary boilers, it may be mentioned that the transport of *astatki* from Baku to the

Caspian seaports and Astrakan, amounted in 1892, to 107,361,435 poods, equal to about 3,000,000 tons; and, in addition to this, some 250,000 tons were shipped from Batoum. The statistics for 1893 are not yet available for reference, but will probably show an increase.

In the above mentioned tonnage the consumption in Baku, which amounts to more than 100,000 tons yearly, is not included. Astatki is the only fuel used at the boring of the wells, and for all distilling purposes, in some cases even for domestic use in warming and cooking stoves. The consumption in this latter way is of course insignificant, but may be mentioned as showing the possibility of using it for this purpose. The arrangement is as follows:—A tank is placed somewhere on the top of the house, and a system of half-inch pipe leads the oil to the different stoves, where it is allowed to drip on to a small cast-iron disc or plate, placed in front of the stove door, which is provided with a small opening creating a strong draught; when once the plate is warm and the dripping of the oil is properly regulated, it burns without further attention.

For boiler and distilling purposes it is necessary to create a larger and more powerful flame, and steam is used for forming it into a spray which is easily ignited, and then burns fiercely. Many injectors or pulverisators in Russia, called *fasunkas*, have been constructed and patented, but it has been found that the most primitively constructed pulverisators answer as well as the more complicated kinds. The apparatus used under the stills consists simply of two half-inch pipes, one leading the oil from a tank, the other steam from a boiler. The ends of the pipes are flattened by a blow of a hammer, and then tied together with a piece of wire; the steam jet catches the outflowing oil and forms the spray. It is well to keep the oil a little warm to facilitate its passage in the pipes through which it descends by gravitation. This pulverisator gives entire satisfaction; the flame is powerful and bright, and not a drop of oil is wasted when once the flow has been regulated. No smoke or flame ascends the chimney—which, by the way, can be very short—as the steam jet itself creates sufficient draught. A somewhat neater appearance can be given to the injector when the oil-pipe is arranged inside the steam-pipe, and provided with a cast-iron or brass nozzle which can be shaped to give the flame any desired form. As far back as 1880 I had occasion to make, on behalf of Messrs. Nobel Brothers, in St. Petersburg,

some experiments with oil firing before a committee of the Russian Admiralty. At that time *astatki* firing was a novelty. The object was to demonstrate its practicability for firing marine boilers. The pulverisator was of a somewhat complicated construction. The results were, however, satisfactory; the boiler used belonged to a steam launch.

Experiments have been made with compressed air for spraying the oil, but the results have not materially differed from those obtained with steam. Air must, of course, in any case, have access to the flame, and openings on the front of the flue must be provided for its admittance. In most cases the hole in the furnace door through which the nozzle of the pulverisator is introduced, is sufficient for letting in the quantity necessary for the combustion. The action of the steam is therefore solely mechanical, and serves only for cutting up the oil in small particles, which being surrounded by the necessary air for their combustion, catch fire before they reach the bottom of the flue. By using steam for spraying, no oil accumulates in the flue when the flow is regulated, consequently, a complete combustion of the oil takes place. If better results should be obtainable by using compressed air for spraying, the reason would have to be looked for in some chemical effect of the steam upon the oil which, to some extent, could deprive the latter of its heat-creating properties. There is, however, no probability for this anticipation; if the steam had this effect, it would already have done its work in the still, where superheated steam is admitted into the crude oil to facilitate the distillation of the different crude oil products. Looking at the question from the point of cost, it is not probable that the compressed air can be produced cheaper than the necessary quantity of steam taken direct from the boiler. It is, in fact, but a very small quantity which is necessary for doing this work, when the pulverisator is properly constructed; and no case has come to my knowledge in Russia where the adoption of liquid fuel has augmented the quantities of feed-water used in a perceptible degree. The chief point in the construction of the pulverisator is to avoid waste of steam, that is to say, to construct the nozzle in such manner that every particle of steam takes care of a corresponding particle of oil. This object will best be secured when the openings for the steam, as well as for the oil, are made long and narrow, and are placed

as close to one another as possible. All the different Russian constructions are made in this way. The openings are about $1\frac{1}{4}$ inch long, and $\frac{1}{8}$ inch to $\frac{1}{4}$ inch wide. As the oil sometimes contains paraffin, which is likely to choke this narrow opening, it is essential to have an arrangement by which steam can be led through the oil-passage to clean it out. The rest of the construction may be varied to suit particular cases, and with a view to facilitate and cheapen the manufacture.

At the present time a great many ships on the Black Sea, and all steamers on the Caspian Sea, as well as all locomotives in Southern Russia, burn *astatki*. The general advantages obtained by using liquid fuel in any boiler, whether stationary, locomotive, or marine, are the following:—It can be adapted to any construction of boiler without material change in the existing arrangement for firing with coal, in fact, coal and oil can be used alternatively if so desired. The fire-bars have simply to be taken out or covered with thin slabs and cinders. The furnace door has to be provided with a hole for introducing the nozzle of the pulverisator, and the steam-pipe and oil-pipe have to be connected respectively with the boiler and the oil-tank. The steam generating power of *astatki* is considerable; one ton of oil is, in this respect, equal to more than two tons of best steam coal, and is often claimed to be equal even to three tons of coal; it depends, of course, upon the quality of oil and coal used for the comparison. The fire can be extinguished instantaneously, and is absolutely free from smoke or ashes. The frequent opening of the furnace doors can be avoided, thus saving heat and preventing leakage of tubes, due to currents of cold air. Rapidity in raising steam, and complete control over the fire, are secured, thus avoiding waste of steam by the safety-valves, and the boiler pressure can be regulated better than in the case of coal-firing. After mentioning these general advantages a few words may be added about the special advantages accruing to railways and steamships. The valuable spaces at railway stations, which have now to be sacrificed for accommodating coal supply, could be reduced by about two-thirds, as only half the tonnage would have to be kept in stock, and this quantity can be stored more economically in point of space than the same quantity of coal. A considerable amount of labour employed in storing coal and loading tenders can be saved, and the oil can be taken in simultaneously with the water supply, as

quickly and in a like manner. The avoidance of smoke and blowing safety-valves will greatly add to the comfort of the passengers, a point for which the railway companies are usually prepared to make considerable sacrifices.

The hard work of the stoker on an express train is reduced, as far as firing goes, to simply giving the regulating valve of the injector a turn from time to time, and the absence of dirt and smoke makes the service less disagreeable than with coal-firing.

For steamships, the advantages of using liquid fuel are of still greater importance. Much valuable space which has now to be sacrificed for the coal-bunkers can be saved; the oil can be kept in ballast-tanks at the bottom of the ship, an arrangement which greatly augments the stability of the vessel, and the oil can gradually, as it is consumed, be replaced by water. The size of the stokehold can be reduced considerably, and the number of stokers diminished in the proportion of one to four. In stormy weather, and in case water should gain access to the stokehold and put the fire out, it is considerably more troublesome, and takes more time to relight a coal fire than to restart the oil fire, and the risk of accidents by scalding is diminished. The danger of fire in the coal-bunkers will not be replaced by any similar risk connected with the use of oil. Lastly, it may be mentioned that a ship having oil at its disposal may, by pouring a certain quantity overboard in stormy weather, avoid much trouble. For torpedo boats the use of liquid fuel is possibly of still greater importance than for any other vessels: the entire absence of smoke will help to avoid detection and possibly destruction, and the saving in space is of the utmost importance as well as the possibility of raising steam quickly. The last years have seen a complete revolution in boiler making. Water-tube boilers seem to be the type of boiler for the future. Various constructions are in the market, and a keen competition is going on for the best designs. Without going into details, it may be mentioned that the principal merits claimed are reduction of size and rapidity in raising steam of high pressure. Oil-firing greatly furthers these ends; fire-grate and ash-pit can be done away with altogether, the length of the funnel can be reduced, and a system of water tubes is better suited to the fierce fire of liquid fuel than the straight or curved surface of an ordinary thick boiler plate. No boiler specially designed for liquid fuel is yet in the market, but the subject leaves

certainly a wide field open for the boiler designer who, with liquid fuel, can obtain a flame which can be controlled, directed, and given uniformity much better than a coal fire, and which is less dependent upon air-currents.

Besides serving as a combustible, there are many minor outlets for the sale of *astatki*. It forms an excellent lubricant as it is, and by mixing it with other substances, several lubricants of a higher class can easily be created without submitting it to further distillation. A very good and durable paint of various colours can also be made with it. Brick-built dwelling-houses have been painted with *astatki* to avoid moist and damp walls, and it answered very well.

A disposition to use liquid fuel has already been shown in this country, both for locomotives and steamships. A certain number of locomotives, and even stationary boilers, have been fitted to use oil, and have burnt the tar oil which was obtainable. A small quantity also of *astatki* which had been shipped to this country has been employed for steamship use.

Now the question arises—Can this combustible be obtained in sufficient quantities, and at a cost which will secure a general use of it? As regards cost, it is evident that the best market can be expected in countries where coal is expensive and where oil can be got cheaply; it is, therefore, not at present very probable that this fuel will be adopted to any considerable extent in this coal-producing country, with its annual output of 185,000,000 tons. But in parts within the British dominions and elsewhere, where oil is found on the spot, and where coal is expensive, especially in tropical climates which are detrimental to the quality of coal, very good markets could certainly be created. Up to the present time, oil-fields have generally been looked upon as sources for lamp-oil only; the principal question has always been to obtain oil capable of yielding a high per-centage of this commodity, and the residue has been considered as more or less valueless. There exist, however, places where heavy oil not capable of yielding more than, say, 20 per cent. of kerosene, could be sold as liquid fuel at a very large profit, and I propose in the following to say a few words about the worked as well as about the yet unexplored oil-fields which may be looked forward to as sources of supply.

SUPPLY.

America and Russia produce very different classes of crude oil. The American oil gives

about 80 per cent. of kerosene, and the remainder is partly utilised for making other petroleum products. There is, therefore, no likelihood of getting any great supply from these fields. The Russian crude oil, on the other hand, only gives about 35 per cent. of kerosene and other products, leaving 65 per cent. of *astatki* for fuel; there are therefore, if not unlimited, at least very considerable quantities at hand from these fields.

At present, no oil territories which approach the American or Russian in magnitude are worked, and how far such enormous quantities of petroleum will ever be found anywhere else is difficult to form an opinion about; all that can be said is that several places in different parts of the world present quite as good indications of the presence of oil as the others did before they were worked. Nothing but actual boring can give full certainty about the importance of any particular oil-field, and even the boring of a very limited number of holes, which may have proved to be dry holes, are not absolutely conclusive. Here, again, the Russian fields furnish a good example; the first borings were made at a place called Surachaney, where the escaping gases seemed to indicate a most probable presence of oil, but the borings yielded none, or but little, whereas not more than two miles away from this place, the Sabuntchy fields have produced the enormous fountains, the magnitude of which has been so astonishing, and it is there that the pumping, or rather bailing, wells are now in full exploitation, so to say, side by side, the average distance from one to the other being only 100 yards.

In regard to other existing sources of supply, the later years have seen important oil industries carried on in Burmah, Canada, Galicia, Sumatra, Java, Japan, and Peru. At some of these places the oil is of a quality more like the American than the Russian, and produces principally kerosene, leaving but a small per-centage available for fuel. At others it is heavier, as in Java and Peru, in which latter place liquid fuel has been adopted by several railways for their locomotives, and some steamships are also run with it.

The last years' general depression in trade and enterprise, and the cheapness of petroleum from American and Russian sources, have, to a great extent, checked further development of oil-fields, but with a general revival of trade and higher petroleum prices, there is a great probability of enterprise being directed to the many yet undeveloped fields

which at present exist, and of which several are situated within British territory. It may, therefore, be suitable briefly to mention the most important which are likely to be exploited or further developed, and to offer a few remarks on the work in connection with such development.

To begin with the fields within the British dominion, the oil-fields of Burmah have yielded a considerable quantity of oil, and large areas not yet exploited are reported to present good indications for further operations. An extensive oil industry in that part of the world would be of enormous importance, both as a source for lamp oil and fuel; some of these fields are situated in proximity to the sea, which greatly enhances their value.

Several islands in the West Indies give also very good indications of oil, the most remarkable being the extensive pitch lakes in Trinidad, which seem to warrant the presence in deeper strata of heavy oils, exceedingly suitable for giving liquid fuel. Canada has also, in late years, developed an extensive oil industry, but the petroleum there is more like the American, and gives but little residue.

Outside British dominion, Mexico may be mentioned as a source for oil. Numerous indications are present, both on the Pacific coast side and on the Gulf side, and borings are now going on there.

BORING.

Boring for oil may be said to date from 1859, when Colonel E. L. Drake bored the first well in Pennsylvania, since which more than 60,000 wells have been drilled in Pennsylvania and adjoining States. In Russia, boring operations commenced 20 years' later, and the number of wells drilled is considerably less, but they have been more productive than the American. On account of the different geological formations of these two countries, the modes of boring are different, as well as the form of the wells. In America, a well is often drilled through rock, from top to bottom; the average diameter is 8 inches at the top, and the depth is about 2,500 feet. A complete outfit for drilling such a well costs 10,000 dollars, and the wages of the drillers is three to four dollars a day. If drillers are secured for work outside the United States, they receive 125 dollars a month and travelling expenses.

In Russia, a well is 20 inches to 24 inches in diameter at the top, and has a depth of about 800 feet. The boring mostly is made by contract, and the total cost of a well may be put

at 30,000 roubles, or £3,000. When a new territory has to be taken in hand, it is, however, a mistake to start with securing such costly drilling outfit, the use of which only can be justified when the development has reached a more advanced state, and when it has been ascertained what strata have to be dealt with, and some arrangement has been made for transport and repair of heavy outfit.

The safest and most practical way to proceed will, in most cases, prove to be the following:—After thorough surveying of the particular field by competent experts and geologists, and after having located a number of places suitable for trial borings, the necessary plant has to be brought into operation, not so much with a view of getting hold of the largest quantity of oil, for the storage of which no provision has usually been made, but for ascertaining the depth at which the oil will be struck, and as a guide in defining the extent of the oil-bearing strata. For this purpose it is not necessary to go beyond a depth of say 1,000 feet. If the strata met with, and which has to be carefully recorded, do not give satisfactory results, another place has to be tried, and so on, until the operators have thoroughly sounded the ground, and are perfectly convinced that plant for larger and deeper wells is justified. The cost of plant, the amount of skill required in the operations, and the time employed progress at a much quicker ratio than the depth; in other words, a 3,000 feet boring costs more in money and skill than, say, five borings 1,000 feet each; and a territory is much better tested by 20 borings of 500 feet than by five borings of 2,000 feet. If oil is found only at 3,000 feet in a new territory, it does not, in fact, present very encouraging prospects, unless, of course, the quantities found should be found to be very considerable; but, as a rule, and very naturally, the level of the oil lowers when a territory is tapped, and it may soon prove more or less valueless on account of the costly deep drilling not being justified by the output. To give any hard and fast rule for the depths to which it is worth while to drill in a new field depends naturally on many circumstances which have to be taken into account in each particular case, the prices to be obtained for the oil, the geographical position of the place, and so on. In some cases not only heavy drilling plant, but storage tanks, and even refineries have been put up before the quantity of oil found or likely to be found were ascertained. Such proceedings cannot, of course, be justified. Supposing abundance

of oil is suddenly found, that a well or even a fountain is struck at 45 feet, as has been the case at Baku, the wisest thing to do is to let it flow or try to plug the well. Precautions must then be taken that a similar occurrence is provided for a second time, and excavations in the ground properly lined, or iron or wooden tanks may be held in readiness.

To indicate a fixed sum which will prove sufficient for test work in all cases is of course not possible; but, a drilling plant for a 4 foot test hole, 500 feet deep, with necessary casing complete, for hand work, can be had for £350. By hand the work, however, progresses somewhat slowly, and in most cases it may be advisable to use steam-power, which can be secured for an additional sum of £125.

The system to be recommended for such borings are the ordinary Artesian well boring, with rods and ropes and portable derrick; for later borings a fixed rig iron and wood for use of the American and Canadian boring system and heavier tools may be adopted. One outfit for every two, three, or even four test holes may be sufficient, and requires but one experienced man with two unskilled helpers for its manipulation. If steam-power is used an additional man will be required. Responsible technical supervision of the operations are of course indispensable in any case.

In the foregoing I have tried to point out which oil forms the best material for liquid fuel, to describe its manufacture, its absence of danger, and the manner in which it is burned for different heating purposes. I have also endeavoured to draw attention to the many yet undeveloped fields from which it can be obtained, and, lastly, to indicate briefly the manner in which the preliminary exploration of new fields has to be carried out, in order to minimise expenditure, before sufficient certainty of success has been ascertained. As already mentioned, a more general adoption of liquid fuel will greatly increase the value of the oil-fields, especially of those which yield a product more or less unsuitable for the manufacture of lamp-oil, and it is to be hoped that these fields will, in the future, receive the attention they deserve.

DISCUSSION.

The CHAIRMAN said that having travelled in steamships and on railway trains, fired with liquid fuel, he could fully confirm what had been said as to the advantages of that description of fuel. In the stokehold of a ship where solid fuel was employed

there was a little army of grimy, perspiring coal trimmers and stokers, and their work was very trying in tropical climates, and often caused death or serious illness; but where liquid fuel was used, all that was necessary was to regulate the valves from time to time; and he had been on steamers of considerable size where a single attendant did all the work, and then was able to spend a great part of his time in reading the paper. Having already said something as to the leading part taken by Russia in the development of liquid fuel, it was only right to add that at an earlier period a good deal of attention was paid to the subject in this country. In 1830, the use of hydrocarbons for raising steam was advocated by Pinkus; in 1864, a number of trials were made at Woolwich with an apparatus invented by Richardson, and in the same year the apparatus of Bridges Adams was tried experimentally. In 1868, the Government tried a system invented by Wise, Field, and Aydon, which about that time was put into practical operation at the works of Messrs. J. C. and J. Field, the candle manufacturers. In the same year an apparatus invented by Crowe was tried by the Admiralty, and about the same time a successful trial was made with a vessel of about 500 tons, the *Retriever*. About 1862, considerable attention was devoted to the subject in the United States, and large numbers of patents were taken out for apparatus for burning liquid fuel. In 1870, he believed the first steamship was fitted up in Russia on this system. Again in England, in 1886, the Tarbutt and Quentin system of burning liquid fuel was put in practical operation. It would appear, therefore, that the practical supremacy of Russia had been largely due to the fact of her possessing such large supplies of necessary material, but it was worthy of note that although in America there were enormous supplies of oil, attention was not directed to the substitution of liquid for solid fuel until long after it had become an established fact in Russia. In Argentina liquid fuel was adopted on one of the railways in 1890, and there were twelve locomotives burning it. In Peru also there was a large and increasing demand for it, and anywhere along the coast where supplies could be obtained at a reasonable cost there was no difficulty in selling practically any quantity. Within the last few months the *Baku Standard*, a petroleum tank steamship, had been driven across the Atlantic by liquid fuel, and this again marked an important epoch. Unfortunately she had by no means a favourable passage; she encountered icebergs and head winds, and stormy weather, so that her voyage was a long one, but the fact of having crossed the ocean successfully notwithstanding these difficulties was perhaps a better test than if she had fair weather. Again, Mr. Holden, of the Great Eastern Railway, had devoted a great deal of attention to the utilisation of liquid fuel, and for a long time had had a number of locomotives at work fired in that way. In the United States, during recent years, there had been a great increase in the employment of liquid fuel for purposes

other than steam-raising, and, in glass works particularly, he understood it was found to give very satisfactory results. It was with some disappointment that he heard what Mr. Stockfleth said as to the burners employed; a large number of patents had been taken out for appliances of this kind, and it was a pity that the amount of mental labour devoted to this matter should not have resulted in the attainment of commensurate results. It might be however that, though the comparatively primitive burners gave perfect satisfaction in Russia, that might arise from the abundance of the material, which obviated the necessity of great economy in its use, and that if they were subjected to critical comparative trials, other burners would be found superior. But apart from the question of economy, there were other points to be considered in judging of the relative value of these burners. The question of noise was of some importance, as he had sometimes found that this noise from an ordinary Russian pulverisator was, to a certain extent, a nuisance, and that some burners were more noisy than others. Again, certain burners required more steam in relation to the work they were doing than others, and this was a point of great importance, for one obstacle in the way of introducing liquid fuel on steamships had been the difficulty of making up for the loss of steam required in the pulverising of the oil, and in some cases it had been suggested that it would be necessary to have an auxiliary distilling apparatus, to supply to the boiler, in the shape of condensed water, an amount equivalent to that used by the pulverisator. There was also a great difference in some of these burners in the character of the flame; some gave a flame of the blow-pipe character, a long, pointed flame, which was liable to do considerable damage to the boiler-plates if allowed to impinge on them. With regard to the economy of liquid fuel, as compared with coal, it had been pointed out that we had not as yet any boilers specially designed for the use of this fuel, so that they did not yet know what was the real thermal efficiency of liquid fuel as compared with coal. In some cases double the efficiency had been obtained, and in others three times had been claimed, whilst Admiral Selwyn asserted that the superiority was much greater still. The question of supply was of great importance, and in this country the price stood in the way of any extended use of liquid fuel. In a recent number of the *Shipping Gazette* it was stated that experiments with liquid fuel on one of the steamers on the Clyde were being discontinued, because the oil employed had risen so much in price that it was found more expensive than coal. Unfortunately, up to now, users and producers had waited for each other, and it seemed to him that there ought to be a little more courage on the part of those who had valuable sources of supply in developing them. There was too much disposition to wait until they were assured of a demand for so many thousand tons per annum; while, on the other hand, those who might be inclined to use this

material, said they could not be expected to make arrangements to use it, until they were assured of a constant supply at a certain price. The result was, there had been almost entire stagnation. It also seemed to him that, even if oil were more costly than coal, there were cases in which it would be desirable to use it, as, for instance, on the Underground Railway, for the sake of avoiding sulphurous fumes, and in electric lighting stations in London, where there would be a great saving of space in storage, fewer vehicles would be required to transport it, there would be no ash or clinker to remove, and the amount of steam required could be increased much more readily to meet sudden emergencies, such as a heavy fog. There were so many purposes to which petroleum could be applied, including the manufacture of gas for illuminating purposes, that he thought the future historian would very likely regard this as the age of petroleum.

Mr. NELSON BOYD said the calorific value of the petroleum, taking it on the average to contain 85 per cent. carbon and 15 per cent. hydrogen, would work out at about 20,000 units, compared with 14,000 for coal, but the results obtained in practical working were much larger. That arose from several causes. The combustion of a hydrocarbon was much more perfect than that of coal; there was not the loss in smoke and clinker, and in locomotives there was none of that coating of the tubes with carbon, which interfered with the conduction of the heat to the water in the boiler. One ton of petroleum was therefore worth two tons of coal, if not more. The great difficulty in England was the price. At present he did not think any quantity of the sort could be obtained at low as twopence a gallon, which would represent 46s. 8d. per ton, and if it had twice the calorific value, that would be equal to coal at 23s. a ton, and they could get the very best steam coal at much less than that. In Cardiff it only cost 12s. or 13s., and a very serviceable coal could be bought for considerably less. That was why liquid fuel was not used in ships, locomotives, and furnaces generally. Of course, on board ship credit must also be given for the absence of smoke, the facilities in handling, and the consequent economy in labour; but making allowance for all that, 2d. a gallon was more than the shipowner could afford to pay under present circumstances. Possibly in future, if coal reached a permanent famine price, things might be altered, and petroleum might have a chance when coal was 15s., 16s., or 20s. at the pit's mouth. Another important point was the quantity of steam required for the pulverisators. The reader of the paper said, if the pipes were properly arranged, the thing worked well, gave little trouble, and cost very little money; but in opposition to that he might bring forward statements from the technical journals with reference to the steamer which crossed the Atlantic, that for every ton of fuel used it required a ton of water from the boiler in the form of steam. This

was a very costly business. It had been stated that the burners were not of a good pattern, but all this had to be taken into consideration. On rivers where there was fresh water available, this objection was diminished, and he believed that in the Caspian the water was not very salt, on account of the immense flow of fresh water from the Volga. There it was patent to everybody that astatki being practically a waste substance, any loss that occurred was unimportant, but in England the matter was very different. The material had to be brought from a long distance, and cost a good deal only for transport, and at present he did not think a gallon of any kind of liquid fuel could be delivered in the Thames under 2½d. The use of liquid fuel on the Great Eastern Railway was a special matter. Mr. Holden used the refuse from his own gas-works and from other gas-works, which he obtained at a nominal price, but if he had to go into the market to obtain a supply for all his locomotives it would be a very different matter. No doubt there were large districts on the other side of the Atlantic where enormous tracts of petroleum were only waiting for capital to develop them, but it was far easier to transport petroleum to England, than to transport the necessary capital to the West Indies; but as to the existence of those deposits there was no manner of doubt. There were tracts both in Mexico, in the West Indies, and in other places, where immense deposits of petroleum were awaiting extraction, and if they were brought without rectification, possibly they might be delivered in the Thames at a price which would meet the requirements of engineers.

Mr. EDWIN HENWOOD said he had some considerable experience of liquid fuel, and for four months he ran his yacht *Ruby* on the Thames day and night, which although not very big, was as large as the original *Rocket*, which was the first steamer on the Clyde. The only difficulty he found was that the small amount of oil used required a pinhole adjustment, but with larger vessels, of course a larger hole would be necessary, which would allow the oil to pass through freely. He found the evaporation obtained was considerably over 3 to 1 as compared with coal, and he had even exceeded what was claimed by Admiral Selwyn. He had been able to melt fire-bricks, and bring them into a liquid mass, like honey, without any difficulty. The *Baku Standard* which crossed the Atlantic, was reported to have consumed over 20 tons of oil a day, as against 33 tons of coal, but unfortunately the owner did not follow the advice for which he asked, but employed a very imperfect system, or he might have done with a condenser and imperfect system. For last year Mr. Suart was invited by an eminent firm of merchants to meet him (Mr. Henwood) at their offices, and was so satisfied with the success obtained with the yacht *Ruby*, that he stated he would adopt the system, and requested plans, specifications, and estimates for fitting

his steamers according to his (Mr. Henwood's) plans, which had been approved by the Committee of Lloyd's Registry, in 1891, and as carried out in the *Ruby*, whereby one ton of oil was made to do the work of three tons of Welsh coal, coupled with the exclusion of manual labour. In the *Baku Standard* such a result has not, it appears, been obtained. The steam was also used in a wasteful manner, and he was informed that the funnel was made red hot. Still, they found that only one man was required in the stokehole, and he had hardly anything to do but sit still and smoke his pipe. That was what his stoker told him in 1887, though the Lancashire boiler was at work day and night continuously for four weeks. On the question of supplies, he would first refer to the finding of petroleum in Somersetshire, though he did not know to what extent that had proved a success; but, apart from that, there was an immense amount of shale in this country, reaching right through, from the south up to Yorkshire, from which oil could be extracted at very little cost, sufficient to supply, at under £2 a ton, all the wants of the royal and mercantile marine. Again, in Canada, there was a large tract of land adjoining the Athabasca river which might be made very productive; and, though there was a question of accessibility, he believed a moderate pipe line would bring it to a seaport. There was also another large supply near the mouth of the St. Lawrence. Again, in Trinidad there was an immense amount, but the impost of 8s. a ton made it very difficult for capitalists to deal with it, when the cost of transport was added. In Venezuela, also, there was a large amount of oil, and round the Gulf of Mexico and in the State of Columbia, there was an immense amount, which was spoken of in the works of Von Humboldt in 1849, and ever since that date the oil had been running into the sea, and it might without difficulty be brought to this country, and delivered at less than 30s. a ton. Mr. Boyd said oil at anything over 2d. a gallon could not compete with coals, but he overlooked the fact that a vessel going a long voyage, which had only to carry 1,000 tons of oil, instead of 3,000 tons of coal, would have room for an additional 2,000 tons of cargo, paying, perhaps, £2 a ton for freight; besides which, there was an immense saving in labour, and in the delay and nuisance inseparable from coaling.

Mr. W. WARREN, Assoc. M.I.C.E., said he thought the vibration referred to by the Chairman, as arising from the combustion of the oil on its introduction into the furnace, generally arose from the injector being put at too high a point, so that there was a constant succession of small explosions. If the injector were pointed more downwards the combustion took place gradually, and there was no noise. In some cases arrangements were made for increasing or decreasing the amount of air necessary for combustion, and in that way vibration could be entirely got rid of. In his own experience, in Russia, with Mr. Urquhart, the noise was entirely removed by simply

spraying the oil. With regard to the excessive consumption of water on board the *Baku Standard*, he was surprised, after so many years' practical experience in Russia, that some better means was not adopted, and his own opinion was that the injector must have been of very defective construction, and its application still worse. In their own case, for welding and crucible furnaces, they simply took a small pipe from the blower used for providing the blast to the forges, the pressure of the air being from 11 to 13 oz., and with that they got extremely good results in the welding furnace producing extremely clean forgings and heats. He could not but think that a small auxiliary engine and fan would have provided sufficient air for combustion, and that the *Baku Standard* voyage might have been a much greater success. Of course it was good in its way because it solved a question which many people doubted. On the question of supply, there could scarcely ever be sufficient oil available, no matter how large the quantities, to enable it to displace coal, as some people thought. The entire quantity of oil produced in the United States last year was some 37,000,000 barrels, of which 60 per cent. might be taken as illuminating oil, the remainder being benzine, naphthas, and astatki, which would come to about 1,500,000 tons. The question had often been put to him whether there would not be too much oil produced, but that was easily answered, for one single railway in America, the Pennsylvania, used upwards of 5,000 tons of soft coal a day, so that it would use the entire quantity of the residuum of oil suitable for fuel produced in the United States. In Russia the case was rather different, taking the light and heavy oils of Russia there was not more than 30 per cent. of illuminating oils obtained, leaving 70 per cent. of benzine, naphthas, and heavy oils, which might be used for fuel, but of course that meant that nothing would be available for the production of the even more valuable lubricating oils. The entire quantity, if the whole of it were available for Russia and America, would be less than 10,000,000 tons. Now the production of coal in England, in 1892, amounted to 183,000,000 tons, and in the United States it was 181,000,000 tons, or, putting it roughly, in these two countries the production was nearly 400,000,000 tons, whilst at the present time there was not produced more than 10,000,000 tons of oil. There need be no apprehension, therefore, on the part of anyone, that the production of oil would ever exceed the demand.

Sir WESTBY PERCIVAL (Agent-General for New Zealand) said he had been a sufferer from his connection with a company which tested some very valuable oil-fields in New Zealand, but he thought they had been too easily discouraged by thinking they would not get a profitable market. There was no doubt of there being large deposits of oil in New Zealand.

Mr. W. G. TREWBY said there had, as yet, been no

direct comparison made between the cost of coal and oil for fuel. Russia appeared to be the only country which had developed the use of oil for railway or maritime purposes, which might be explained by the fact that coal in Russia was of very poor quality. He found by the report of the Odessa Water Works Company that a large sum was spent for English coal, and on inquiring why it was not obtained near at hand, he was informed that it paid better to give three times the price for English coal.

Mr. WARREN said, with reference to this question of relative cost and economy in Russia, coal of excellent quality was obtained from the Donetz district at a cost of about 14s. 8d. a ton, whilst the oil brought from Baku to Astrachan, and thence about 400 miles up the River Volga to Tsaritzin, costs 21s. or 22s. a ton. Oil was therefore used exclusively, there being 145 locomotives on that line alone, while there were in all some 1,500 locomotives using liquid fuel in Russia. There was a very great economy not only in the fuel itself, but also in the cost of maintenance and repairs, owing to the absence of dust and clinker. In his experience of these rates of cost, the economy was 52 per cent. in favour of oil.

Mr. S. S. BROMHEAD thought it had been shown pretty clearly that petroleum oil, in any form, had little chance in this country in competition with coal for raising steam furnaces or other manufacturing purposes, but, on the other hand, there was a large field in which it might be economically employed, viz., in substitution for animal power. When at Grantham, recently, he found that the eminent firm of Hornsby and Co. had been engaged in carrying out experiments for the purpose of making carriages to be driven by petroleum, and at a time when there was a cab strike, and thousands of horses were eating their heads off in the stables, such an idea commended itself very forcibly. Again, the domestic use of petroleum for warming and cooking might play an important part in the abolition of smoke and fog in London and other large towns.

Mr. E. CHARRINGTON said the statements in the paper as to the calorific value of astatki compared with good Welsh coal, were very similar to what he had found himself. Some people said that one ton would do as much work as three or four tons of coal, but in actual practice it came out about 10 per cent. better than two tons. Some experiments were carried out about a month ago on three injectors under a large copper at one of the London breweries, which was doing exactly the same work every day, and he found that they got the results he had mentioned. Of course, astatki was expensive here, and cost 25 per cent. more than the green oil, creosote oil, and tar residuals which they had been using. A ton of mixed green oil and creosote oil was equal to about 2 tons of coal, and, comparing the cost at 2d. per gallon, it came out equal to 16s. 6d. a ton

of coal delivered in London. Of course, there was a limited supply of creosote and green oil, and at present they were using creosote only, which gave a result a little over two to one; petroleum gave about 10 per cent. better. This last year, unfortunately, had been a very bad year for the home production of tar residuals, because there was so much heat and light that the gas companies had very few residuals to dispose of, and the price had gone up. He should be only too glad if anyone found out a means of using astatki so as to make it do three or four times the work of coal, as there would then be a good market for it even at the present price. On the Great Eastern line there were 25 locomotives running, by Mr. Holden's system, and during the coal strike even the use of petroleum was found to pay, but the Great Eastern Company was under exceptional circumstances; they got their material delivered at 3d. per gallon, and they put oil tanks into sidings, and got them filled from various gasworks along the line, and then a pilot engine brought them to the works. The cost of transport was the chief trouble. There were various types of boilers, but, with locomotives, two injectors would keep up steam very well to 700 horsepower, whilst the same injectors on stationary locomotive boilers would maintain about 80 to 100 horsepower, whereas with tubulous boilers they would keep up to 160-200. The effect, therefore, varied very greatly according to the type of boiler and the draught. He knew of a case in which this system was introduced to save the expense of putting up a chimney shaft. But in England, unlike Russia, it was absolutely necessary to have interchangeability. You must be able to use coal one minute and oil the next, if necessary. Some electric light companies were using liquid fuel, but they did it more for auxiliary purposes, and in combination with coal, but not oil exclusively. Mr. Boyd had mentioned that, theoretically, the calorific value of petroleum, compared to coal, was as one and a-half to one, whereas, practically, it was over two to one. That was accounted for in locomotives in this way, that the stoker simply turned off the valve in going into a station, and thus prevented an enormous waste of steam usually generated when coal is used. The amount of steam used in various injectors varied; but, on the average of a large number of stationary boilers in the works at Stratford, the steam used for two injectors, per boiler, was $2\frac{1}{2}$ per cent. of the steam generated in the boiler. Mr. Henwood had referred to the intense heat developed, and the melting of the fire-brick—and that was a trouble they had to get over where it was used in the brewery referred to above. It had to be carried through a brick arch 4 feet thick, and they had some trouble to prevent the arch being melted. It was got over by having the sprays of steam from the atomiser pointing down on to the injected oil, thereby keeping the heat away from the arch. The irregularity of combustion which had been referred to arose

from the injectors not working properly, and that was often found when the furnace was cold. It was only a question of regulation of the air and obtaining proper combustion. At Stratford there was a boiler in which either steam or air could be used, and, with regard to noise, there was not much difference, but it was of great importance that the steam should be superheated and perfectly dry, in order to obtain the best results. One furnace, lined with fire-brick, was used in the forge for heating sometimes five blocks of iron at one time, each weighing about 6 cwt. The furnace was worked entirely by one injector, and the steam-pipes supplying the injector were brought behind the firebrick lining of the furnace, and the steam was so hot you could not see it coming out of either the injector or the atomiser. There was very little noise in that case.

Mr. STOCKFLETH, in reply, said most of the questions raised in the discussion had been already answered by other speakers. In Russia, the consumption of steam was usually estimated at from 5 to 7 per cent. The character of the flame varied with the condition of the oil. If the astatki were used very warm, a more equal and better burning flame was obtained; that was the reason of the success of the primitive injectors used in Russia. In most cases, on board ship, it was not possible to have the astatki at so high a temperature; and, consequently, a better construction of pulveriser was required. On the Black Sea and the Caspian the water was comparatively fresh, and, therefore, it was not necessary to provide special feed water. He believed astatki had been offered in London at 2d. per gallon, but a comparison could not be made by simply taking the cost price of oil and coal respectively; there were many other elements of economy, as had already been pointed out, which had all to be taken into account. Nevertheless it was not likely to be used to any great extent in this country, at present at any rate. He did not think it was sufficiently cleanly to recommend it for domestic use.

The CHAIRMAN then proposed a vote of thanks to Mr. Stockfleth, which was carried unanimously.

Miscellaneous.

THE NEW LOCK AND WEIR AT RICHMOND.

The tidal weir at Richmond, which formed the subject of Mr. J. B. Hilditch's paper before the Society on May 10, 1893 (see *Journal* xli. p. 634), was opened by H.R.H. Duke of York, on Saturday, 19th inst.

The works consist essentially of a bridge of five arches; the three central arches of which are 66 ft. span, whilst the two abutment arches are of 50 ft., that on the Surrey side being built across the lock, and the other over the boat slide on the

Middlesex shore. The girders, which support a double foot-bridge, are of steel. The three central arches are fitted with Stoney's removable sluices, working in grooves constructed in the piers. These sluices are capable of holding up the water to 5' 9" below Trinity high-water mark (or about the half-tide level of ordinary spring tides), and are the largest in the world. They are of steel, 68 ft. long, 12 ft. deep, and weigh about 32 tons each. They are suspended at each end by steel wire ropes of special make, which pass over pulleys connected with the lifting winches. Counterbalance weights are attached to the ends of the ropes. These are four in number to each gate, and weigh about eight tons, and work in wells made of steel plates 3 ft. square, built into the masonry of the piers. These wells also serve to support the vertical guides between which, and the planed surfaces of the ends of the sluices, are interposed the free rollers arranged in such a manner as to take the pressure of the water, and enable the gates to be moved with ease. The gates can be lowered or raised by two men working at the handles of the winches in rather less than five minutes. When the sluices are lifted to their full height they are turned over into a horizontal position in the space between the two footways, whilst these remain hidden from view by the girders and parapet of the bridge, so as to allow sufficient headway for vessels to pass through. The gates will be lowered about $2\frac{1}{2}$ or 3 hours after high-water, and the arches will remain closed till about 2 hours before the following high-water, so that the water on the up-stream side will be maintained at the required level for a period of $7\frac{1}{2}$ to 8 hours, during which time all steamers, barges, or other vessels will have to pass through the lock, and small boats over the rollers. The gates will be raised on the flood-tide, when the water on the down-stream, or London side, reaches the same level as that on the Richmond, and the arches will remain open until the tide has again dropped to 5 ft. 9 in. below Trinity high-water on the ebb.

The sluice gates are so accurately balanced, that the buoyancy of a timber float, fixed on their up-stream side, is sufficient to regulate automatically the flow of the stream beneath, the gates never being quite lowered to the bottom of the river.

The lock is 250 ft. long (72 ft. 7 in. longer than that of Teddington). The entrances have a clear opening of 26 ft. (13 in. wider), and, in order to accommodate a tug and full complement of barges, the lock is widened out to 37 ft. for about two-thirds of its length. The cill level is 16 ft. below high-water mark, which will allow a depth of 6 ft. at the ordinary summer low-water level.

The crest of the boat-slide, which is really a fixed weir under the abutment arch on the Middlesex side, is fixed slightly above the height to which the water will be held up by the sluices. The incline of the three lines of rollers is 1 in 8. The rollers are 3 ft. long, and 3 in. in diameter, placed on the inclines

5 ft. 3 in. apart, in timber framing bolted down to concrete. At the top of each roller path is an iron cradle, 11 ft. long, carrying rollers at each end, and moveable on a rocking spindle, for the purpose of transferring the boats from the upper gradient to the lower, and *vice versa*.

The abutments and piers of the bridge, as well as the walls of the lock, are built of Portland cement concrete, faced with Staffordshire blue bricks and Cornish granite. The first pile was driven on the 1st July, 1891, and the concrete for the foundation of the first pier was put in on the 20th March following, and the work has proceeded without interruption until now.

MEETINGS OF THE SOCIETY.

TUESDAY, MAY 29, AT 8 P.M.—"Black and White in Afrikanderland." By W. A. WILLS.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 28...Geographical, University of London, Burlington-gardens, W., $2\frac{1}{2}$ p.m. Annual Meeting.

British Architects, 9, Conduit-street, W., 8 p.m. Mr. J. Tavenor Perry, "The Influence of the Hanseatic League on the Architecture of Northern Europe."

TUESDAY, MAY 29...SOCIETY OF ARTS, John-street, Adelphi, London, W.C., 8 p.m. (Foreign and Colonial Section) Mr. W. Wills, "Black and White in Afrikanderland."

Royal Institution, Albemarle-street, W., 3 p.m. Rev. W. H. Dallinger, "The Modern Microscope; an Instrument of Recreation and Research."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Annual Meeting.

WEDNESDAY, MAY 30...Patent Agents, 19, Southampton-buildings, W.C., $7\frac{1}{2}$ p.m. 1. Discussion on paper by the President on "The Profession of Patent Agency, Past and Present," and a paper by the Vice-President on "The True Position of Patent Agents relatively to Inventors." 2. Mr. P. Jensen, "Notes on the New Patent-law for Denmark." 3. Mr. A. V. Newton, "Industrial Progress in the Arts, and how it may be encouraged or retarded."

THURSDAY, MAY 31...Royal, Burlington-house, W., $4\frac{1}{2}$ p.m. Antiquaries, Burlington-house, W., $8\frac{1}{2}$ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. W. M. Flinders Petrie, "Egyptian Decorative Art."

FRIDAY, JUNE 1...United Service Institution, Whitehall-yard, 3 p.m. Col. C. G. Mayber, "The Training of Volunteer Infantry."

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Prof. Oliver Lodge, "The Work of Hertz."

Geologists' Association, University College, W.C., 8 p.m.

Philological, University College, W.C., 8 p.m.

Queckett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, JUNE 2...Zoological, Regent's-park, N.W., 4 p.m. Mr. F. E. Beddard, "Sketches in Geographical Distribution." (Lecture III.)

Royal Institution, Albemarle-street, W., 3 p.m. Mr. R. W. Lowe, "The Stage and Society."

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FRIDAY, JUNE 1, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CONVERSAZIONE.

The Society's *conversazione* will take place at the Imperial Institute, South Kensington (by permission of the Council of the Institute), on Friday evening, June 22, from 9 to 12 p.m.

The reception will be held from 9 to 10 p.m., in the vestibule, by Sir Richard Webster, G.C.M.G., Q.C., M.P., Chairman; Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Deputy-Chairman, and the members of the Council of the Society.

Each member will receive a card for himself, which will not be transferable, and a card for a lady. A limited number of tickets will be sold to members of the Society, for the use of their friends, at a charge of five shillings each, if purchased before Saturday, 16th June.

Further particulars as to the arrangements will be given in future numbers of the *Journal*.

EXAMINATIONS, MARCH, 1894.

The results are nearly ready and will be issued in a few days to the various centres of examination, and copies of the list sent for distribution to the successful candidates.

APPLIED ART SECTION.

Tuesday, May 22, 1894; Sir HENRY DOULTON in the chair. The paper read was "Decorative Art in connection with Elementary Education." By SELWYN IMAGE, M.A.

The paper and discussion will be printed in a future number of the *Journal*.

INDIAN SECTION.

Thursday, May 24, 1894; Sir ALEXANDER WILSON in the chair. The paper read was

"The Commerce of Siam in relation to the Trade of the British Empire." By C. S. LECKIE, of Bangkok.

The paper and discussion will be printed in a future number of the *Journal*.

FOREIGN AND COLONIAL SECTION.

Friday, May 25, 1894; FRANCIS COBB, Treasurer of the Society, in the chair. The paper read was "The Industries and Prospective Sources of Wealth in New South Wales." By the Hon. J. INGLIS, M.L.A.

Tuesday, May 29, 1894; SIR CHARLES M. KENNEDY, K.C.M.G., C.B., Vice-President of the Society, in the chair. The paper read was "Black and White in Afrikanderland." By W. A. WILLS.

The papers and discussions will be printed in future numbers of the *Journal*.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday, May 8, 1894; Professor W. C. ROBERTS-AUSTEN, C.B., F.R.S., member of the Council, in the chair.

The paper read was—

PEWTER.

By J. STARKIE GARDNER.

We should scarcely expect to find in these days of art revivals and competition any field practically unoccupied. Yet, though the venerable craft of the pewterer can hardly be called extinct, it is from an art standpoint distinctly moribund. This neglect is the more remarkable because there is no sort of reason why it should be so, and any intelligent revival would have brilliant prospects of success. There is still a Pewterers' Company, which might be induced to recollect the purposes for which it exists, and there yet survive some firms with trained workmen who are adepts at manipulating the metal. For several centuries the pewter-worker was the potter of the community, the *potier d'estain*, as the French called him (one cannot help suspecting some forgotten connection between the terms potter and pewter), and pewter held the whole field since occupied by crockery. Even half a century since the pewterers' list was equal in the number and variety of its items to a modern earthenware potters' Staffordshire list, and

contained articles, the very recollection of whose names and purposes are forgotten; but now it has dwindled to the meagre thing I hold in my hand, which, small as it is, contains much that is practically obsolete.

The reasons that led to the disuse of pewter were primarily the introduction of cheap pottery and glass, together with zinc, block tin, and japanned iron, which are very much cheaper. Secondly, the discovery of more silvery and harder alloys, such as Britannia metal, German silver, nickel silver, &c., more fit for electro-plating, and very much more showy. But these could not so nearly have annihilated the trade, had not the pewter workers, who were mostly old-fashioned and wealthy firms, played into the hands of their competitors by their supineness, and their inveterate habit of making shift with what they had by them, rather than incur any outlay for new patterns. These combined causes were supplemented by the general collapse of good taste that overtook the country, when the era of science first diverted the thoughts and acts of the small leaven of intellectual and cultured workers in the community, from the channels of art, which had been one of their chief outlets, to science and mechanics, which for many years were all-absorbing. These together sufficed to banish pewter so effectually from our households, that until quite lately, the few who had kept their stores of pewter did not venture to let them see the light of day; while the many had sent them to the melting-pot as useless lumber.

There is, however, absolutely nothing in all this to discourage the pewterer, since similar reasons led to the disuse of oak-panelling, casement windows, Oriental carpets, stamped leather, and wrought metal work. Let him take courage, for we look on art differently from our immediate predecessors; and, happy omen, I am told by a friend, whom I see here to-night, that an octagon beaded pewter dinner set sold in a country sale, last March, for £59, while a plain one fetched £22. Keen collectors are already in the field, and old pewter will become a fashion.

The working of pewter as an art craft in France dates back to the time when Jules Bratteau and others commenced the production of most beautiful *plâques* of pewter for cabinet work and *bas-reliefs*, as well as coffee sets, canisters, flacons, and other vessels, both of original design, as well as copies of the great works of the past. In Germany also, most successful work has been

produced, including engraved work, and etching with the effect of niello. American enterprise, though not catching on to pewter itself, is expending large sums to place a metal with not dissimilar artistic capabilities—aluminium—on the market, an aluminium factory on a gigantic scale being one of the group that is to utilise Niagara. I think, however, that pewter as a metal that can be worked without the need of such large establishments and machinery, with its deeply-rooted traditions and harmonies, should easily beat newer, and in some respects, more meretricious alloys out of the field. To digress for a moment, how pleasant it would be when we visit say Killarney or the Hebrides, to be able to bring back a quaint piece of pewter engraved or embossed on the spot with old celtic patterns, as a memento of our visit, and what incalculable good such industries would bring to the inhabitants of lands where winter idleness and the verge of starvation are the present conditions of existence. Vessels in the rough might be produced at common centres, and good people would set the thing going if they knew how, and others with knowledge and capacity would co-operate in such work if haply they came together.

Pewter, by colour a dark subdued oxidised silver, is restful and soft to the eye and smooth to the touch, without the dead and yielding look of lead, or the crude, white, meretricious look of pure tin. It is essentially a compromise and does not pretend to rival silver; nor are the most beautiful works in it to be compared with those gems of last century silver work, the pots and castors which fetch three or four times their weight in gold. It stands in fact towards silver exactly as pale polished brass does to gold, or grey earthenware to fine porcelain. It is an easy, middling, metal, the sentiment of whose sober subdued lustre captivates many who could quite well afford the display of gold and silver plate, if disposed that way.

There is unfortunately, in our language at least, no text-book upon pewter to refer to, and I must therefore begin the story at the beginning, by stating that like its sisters, bronze and brass, pewter is an alloy or mixture of two or more metals. These should be tin and lead, but pewters of a hard kind are made with copper or antimony as a substitute for the lead, or perhaps with small proportions of bismuth, zinc, or silver. The proportions are so variable that it is scarcely possible to exclude any in which

tin forms the bulk, where the result is a darkish silvery soft metal, fusible at a low temperature, inexpensive, and eminently adapted to a variety of household and artistic purposes.

In the presence of the distinguished metallurgist who so fortunately for us this evening occupies the chair, I feel absolved from all necessity of entering into the scientific side of the subject. He is able to, and no doubt will tell us, which are the proper alloys and why some are better than others, and which were chiefly used in the past, for he has, I believe, analysed many of the specimens in the South Kensington Museum, which are lent to the Society this evening. I will merely say that I imagine tin brings almost everything into the partnership, a pure white lustre, lightness, resonance, and the quality of not appreciably oxidising in common air. The lead, no doubt, corrects the want of tenacity and brittleness inherent to tin, gives plasticity, and raises the very low fusing point, rendering the colour, at the same time, richer and bluer. It has the drawbacks that if used in too large proportion the metal tarnishes more readily, and may develop poisonous oxides.

The frequent laws and edicts regulating the pewter trade in the past were mainly framed to check the use of an excessive proportion of lead, by far the cheaper metal, the maximum officially tolerated in England having formerly been about 18 per cent., and $17\frac{1}{2}$ per cent. in France. The precise mixture should naturally be determined by the process of manufacture to be adopted, the use the article is to be put to, and the amount of ornament it is to receive. For art purposes I should fancy perhaps the old tin and lead alloy, which presents the softness, colour, touch, and taste traditionally associated with pewter. That the pewter alepot, almost the sole survivor of multitudinous pewter plate, has endeared itself to Englishmen is due to its being unbreakable, cool, not repulsively hard, inoxidisable, easily cleaned, and perhaps to a reputation for giving taste to beer, explained, as I have heard, by a slight electrolytic action on the lead.

Pewter can be hammered, spun, or cast into shape. The present mode of dealing with it, for my knowledge of which I am indebted to Messrs. Brown and Englefield, successors to the traditions of one of the last of the great pewter firms, is to cast it. The moulds, as you will see by examining one, are of brass or gun-metal, very carefully fitted and massive, and consequently costly. The metal is poured

directly into them, as with lead and zinc; and if hollow castings are required, as in the case of the handles to tankards, &c., the mould is reversed before the metal is chilled all through. What is still molten runs out, leaving a cavity in the interior of the casting, just as in the French art zinc work. As in the latter, it is the initial cost of the mould that is the great expense. The surface of the casting requires no touching except where the surface is to be left plain and bright, when it is turned on the lathe and burnished—operations by no means laborious. After turning, they are generally hammered over to improve their appearance and toughen the metal. Spun, hammered, and embossed pewter, I gather, is no longer made, except in the quality of Britannia metal. Common pewter pots and inkstands are now made of a very low grade of pewter, known as black metal, with the excessive amount of 40 per cent. of lead; while a superior quality has 20 per cent.; and the highest priced metal in the trade, known as tin and temper, is an alloy with copper, in which no lead at all enters. The staples remaining to the trade are hospital wares, inkstands, tankards and measures, and moulds for ices, though some few old-fashioned customers linger on who still require plates and dishes, castors, salts, and sets for Holy Communion.

Tin, as a constituent of bronze, must have been known from remote antiquity, in spite of the fact that its ores are unattractive to the eye. Everything about its early history, however, is conjectural, except that centuries before Christ it was taken in ships by Phœnicians and Carthaginians to Mediterranean ports, and that after Cæsar's invasion it found its way overland, through Gaul, to Italy and the East. The stream tin workings of Cornwall, picturesquely situated among the granite hills of that half-drowned land of legends, are thus almost, if not quite, the most venerable historic landmarks in our isles. It was recorded by Strabo, and confirmed by Diodorus Siculus, that the tin was shipped from Cornwall in small cubes of the size of dice, when its value was perhaps little inferior to silver. Tradition has it that an Irishman, St. Piran, at some unknown date, first imparted the secrets of the manufacture of tin to the Cornish tinmen: but there is no evidence of any incorporation into a guild of Stanners until the time of Edmund, Earl of Cornwall, who conferred privileges, which were confirmed in 1305 by Edward I., who exempted the stanners from all duties, and allowed the singular

privilege of digging for tin and for peat, and turning water-courses, wherever they pleased, without respect to the rights of private property. They were subject to special laws, and answerable to their own wardens of the Stannaries alone, except in capital offences, and their head-quarters and prisons were at Lostwithiel.

Lead has also grown grey in the service of man, and was supplied by ancient Britain to Rome. Ingots or pigs, bearing the Roman legionaries' stamps, lost by the wayside on the long journey from Weredale or Derbyshire, are still frequently picked up. The two metals were only distinguished by Pliny as *Plumbum candidum* and *Plumbum nigrum*. Our trade in lead must have been very large. In the 17th century, 200,000 lbs. of lead, and 8,588 lbs. of tin were consumed in the royal buildings of France in one year, nearly all of which came from England. Versailles absorbed 32,000,000 livres' worth of lead.

The most ancient use of tin as a distinct metal was for the purpose of inlaying various substances, as other metals, wood, and even pottery (in the Swiss Lake dwellings), as well as amber and ivory. Homer and Hesiod describe shields and armour as inlaid with embossed tin, Moses speaks of it among the spoils of the Midianites, and it is mentioned in Isaiah and Ezekiel. The process of tinning iron and bronze, on one side only, was extensively practised by the Gauls long before the Roman invasion, and fibulæ, parts of chariots, and various utensils have frequently been discovered thus coated in France and Belgium. The Merovingians and Saxons were not ignorant of the process. The Romans made excellent looking-glasses from English tin, until silver came so generally in place, as Harrison quaintly puts it, that "in a manner every dish-washer refused to look in other than silver glasses for the attiring of her head." Pewter vessels, too, must have been in common use among them, for Plautus describes a luxurious banquet as served on pewter, and Suetonius relates that Vitellius robbed the temples of their silver utensils and replaced them with pewter. Boxes and flasks for medicaments of pewter are also constantly mentioned. Few actual specimens, however, have survived; some vases and vessels of various alloys have been found in France, and the handle of a vase from near Montluçon, being analysed, was found to contain two-thirds tin to one-third lead. Lead vases, chiefly used for sepulchral purposes, with slight mixtures of tin, are quite

common on the other hand, and as in the case of a magnificent specimen in the British Museum, were sometimes richly decorated.

Owing to the fact that like gold and silver, it oxidises but little, and the oxides are quite harmless, tin has always been included as one of the canonical metals of which sacred vessels might be made; and thus we find chalices and patens made of pewter this thousand years past, whilst the use of all other materials, save the precious metals, has been forbidden since the 7th or 8th century. The greatest use has naturally been made of it in the poorer countries, such as Friesland or Switzerland, but no country has been able to dispense with it altogether for ecclesiastical purposes, and in some, as in France down to the Revolution, it was an almost universal custom to keep a set of pewter vessels for every day use, whilst those of gold and silver were locked away except on festivals. The pewter seems to have been invariably spared by the Protestants in France and the Low Countries when they were sacking the Romanist churches, as when the Duc d'Aumale in 1589 looted the silver chalices in Tours and left the pewter, or when the Prince of Condé so thoroughly ravaged the environs of Paris in 1649, that it was reported that he had left nothing except the pewter chalices in the churches. England appears to have been the only country, and it speaks volumes for her wealth, that seriously attempted to suppress the use of pewter for this purpose. Roger de Hoveden says that it was decreed at a synod at Canterbury in 1175 "that the Eucharist shall not be consecrated in any other than a chalice of gold and silver, and from henceforth we do forbid any bishop to bless a chalice of pewter." It was perhaps in consequence of this that the councils of Nismes and Albi (1252-1254) thought it necessary to expressly permit the use of pewter to poor communities. When in England the ransom of Richard I. made a clean sweep of all the gold and silver church plate of the country, we too must have been glad to fall back on the use of pewter, and the enactment has never since been enforced.

Unfortunately for this history, no early church plate of pewter has been preserved. It is true that lead and pewter chalices, croziers and crosses, were buried with ecclesiastics, but they were but counterfeits of the originals, like the properties of a stage banquet. The singular illustration of one of the very early chalices in pewter, of the 7th century, is from a copy of an old drawing published by Ger-

main Baptist in his excellent history of tin (Fig. 1). It shows that pewter chalices were thought worthy of rich decoration and were of the same shape, with handles, knops and foot, as those of gold or silver. Before passing on, I wish to acknowledge that nearly all I am able to say about pewter in France has been derived from this valuable work, and the inestimable art dictionaries by Havard and Bosc.

In addition to the ministerial, presentation, and offertory chalices of various sizes, there were pewter jars for storing unconsecrated wine and amphoras for holding water for washing the chalices, &c., from the days of Charlemagne to the later Valois, when highly decorative vessels were produced. The inventory of Soignies, 1382, mentions pewter candelabra

FIG. 1.

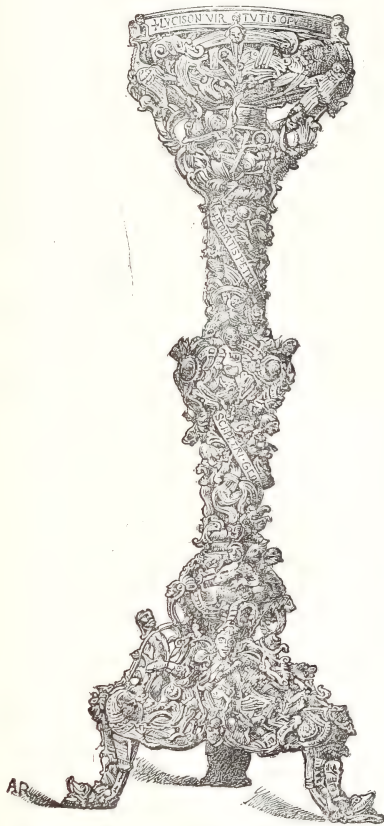


Reduced facsimile of a drawing, made in 1725, of a pewter chalice, now destroyed, dating from the 7th to the 11th century. From the *Révue des Arts Décoratifs*.

and chandeliers, and that of Vence, 1361, six candelabra of tinned iron. None that I can hear of have come down to our times, except, perhaps, the remarkable and venerable candlestick made in Gloucester in the early part of the 12th century (Fig. 2). This unique relic is of a white metal alloy, difficult to class, and consists of a richly worked stem expanding into knops, with a basket-like pan at the top and a rich tripod base. The whole is a mass of small figures of men, birds, monsters, intertwined with volutes, foliage, knots, and inscriptions. A mediæval church chest at Newport is elaborately decorated with ornaments of gilt pewter. In Nuremberg Museum is a beautiful altar cross of pewter which has been mercury gilded. In connection with church pewter, the old English

lead fonts naturally come to mind, but though we have none in pewter, there are some rather handsome examples in Bohemia, of the form of inverted bells on richly foliated tripods. Holy water stoups were very often of pewter. There is a record of a pewter canopy being erected over the figure of a saint in St. Vincent's Church, on the Garonne, in Merovingian times, and Gregory of Tours mentions a basilica roofed with pewter. Finally, organ

FIG. 2.*



The Gloucester candlestick: a work of the 12th century in the South Kensington Museum. From "Gold and Silver Plate," by J. Hungerford Pollen.

pipes consumed a vast quantity of the metal, a record of 1481 showing 14,500 lbs. of pewter absorbed at one time for this purpose. Outside the church, in the cloisters, were lavabos very frequently of pewter, together with pitchers for washing; while kitchen inventories present large arrays of pewter for culinary purposes, and for the table.

This brief *resumé* of the uses pewter has

* This illustration has been kindly lent by the Science and Art Department.

been put to for ecclesiastical purposes is, I think, in the highest degree suggestive. There is no single one to which pewter would not be as appropriate now as in the past, and in this direction alone a great revival of pewter work may be in store. In addition, the roofs of *flèches* and cupolas, which become black when covered with lead, would keep some colour and metallic look in pewter. The same applies to statues, whether internal or external, to finials, gutter spouts, cisterns, and a variety of objects susceptible of decorative treatment, and whose colour we might wish to preserve. A vast and lucrative trade was also carried on by the clergy in pilgrims' signs, badges, and tokens, which were made both in pewter and lead, the monopolies and rights to sell them leading to frequent disputes. These are sometimes most refined and artistic specimens of the highest ecclesiastical art of the day, while again, they may be rude and indecorous. Perhaps no great outlet for pewter work is to be looked for in this direction in the future.

Though the clergy were thus the great patrons of the pewterers, and used pewter extensively long before the laity were educated up to it, yet the necessity for some cheap substitute for silver for domestic use must have made itself felt at an early period. Neither bronze nor brass exactly met the requirements, being liable, like lead, copper, and antimony, to become poisonous. Tin was brittle and unworkable, iron rusted, and the rest of the solid metals were unknown. The happy blending of so exceptionally safe and inexpensive a metal as tin, with some alloy to make it workable, entirely solved the problem. From the time of St. Louis, to whose reign Viollet le Duc assigns the pewter spoon and porringer which he found in the ruins of Pierrefonds, lay pewterers must have been at work; but it was only after such things as ragouts and creams were added to the *menus* in the 14th century that the large and deep pewter dishes made their appearance. The use of pewter for table and toilet requisites commenced in the palaces of popes, kings, and bishops, though actually the first mention of its use is, I think, in an early Templars' inventory, in which pewter quarts and pint measures occur. Edward I., in 1290, possessed 100 dishes, 100 platters, and over 100 salts. In 1328, Clement of Hungary owned 142 pewter porringers. The accounts of John of France, 1351, record payment to a pewterer for six quart pots; and in 1380, Michelet le Breton, Parisian pewterer, fur-

nished 6 dozen dishes and 12 dozen porringers for the use of Charles VI. In 1370, the Bishop of Troyes possessed decanters, flagons and pots, and 14 dozen of porringers in pewter. The Archbishops of Rheims, 1389, and Rouen, 1391, were furnished with an abundance of pewter, comprising alms dishes, covered and uncovered tankards, flagons, cans, canisters, pitchers, ewers, plates, porringers, cups, &c., valued at 7d. to 8d. per lb.

A curious and graceful custom prevailed at this time and afterwards, in which pewter seems to have been invariably in request. This was the presentation to kings or princes upon their stately entry into a city, of the *vin d'honneur*. For this purpose Thibaut la Rue in 1386 furnishes 17 *poz demi-las* to the city of Amiens, and a gallon flagon weighing 28 lbs. is furnished to Rouen to present the wine in to the lords of the Exchequer. Amiens again purchases cups for the *vin d'honneur* in 1463, and as late as 1516 the good city purchases 35 small pewter mugs of Jeane d'Avesne, to present wine to Francis I. and Louise of Savoy. The use of pewter for such a purpose may be explained by the custom among the kings' retinue of appropriating the drinking vessels on these occasions.

Another curious custom associated with pewter in the 14th century was that of hiring by the month or year. Thus we are told that the Archbishop of Rouen commonly hired pewter plate for six or seven weeks at a time, for which he was made to pay very handsomely. The Earl of Northumberland hired 100 dozen of pewter vessels for household use at 4d. per dozen for the year; and in the Hengrave inventory is an item for the hire of nine garnishes of pewter for Christmas.

We cannot more fittingly close this brief and imperfect account of the use of pewter in the 14th century, than with the statement that, according to the contemporary *Ménagier de Paris*, the proper quantity of pewter plate to be provided for a dinner of any pretensions was six dozen porringers, six dozen small plates, 2½ dozen large dishes, eight quart and twelve pint tankards, and two pots for the *aumône*, in other words, to receive surplus victuals to be given to the poor. It is unfortunate that hardly a vestige of pewter work of this date has been preserved. So soft a metal wears away rapidly when in daily use, but, besides this, the small price at which it can be melted and recast has been fatal to its preservation. Thus the king's pewterer, Michelet le Breton, received in 1383 but 24 sols 9 deniers parisien

for recasting two dozen large pewter dishes which had cost 119 marcs, or at the rate of three deniers per marc; and in 1401 Jehan de Montrousti, Isabel of Bavaria's pewterer, delivered six dozen porringers, worth 121 marcs, against a similar weight of old vessels, with a drawback of only two deniers per marc for labour and profit.

The 14th century is that in which pewter was used at the tables of the higher nobility. In the 15th it was in the hands of the gentry, and commenced to generally displace the use of wooden pottery. The Paris *livres des mestiers*, or trade directories, exhibit the commencement of the supplanting of the one industry by the other at an even earlier date.

Naturally in such a case of gradual replacement there could be no sharp line of demarcation, and the gentry no doubt began to acquire a taste for pewter plate, and the means of gratifying it, in the 14th century. This was probably more especially the case in England, always a wealthy country and the home of the pewter industry. Rymer's *Fœdera* (1382) seems to show that services of pewter plate were in the possession of many. The inventory of a *bourgeois* of Normandy comprises a pewter service with vessels for sauces and salt; and we find in the possession of a Canon of Troyes, in 1386, salvers, flagons, mugs, cups, and five dozen porringers. The plentiful supply of pewter pots in the inns and *cabarets* was not even without its drawbacks, for they were used as weapons in the frequent brawls that followed upon drinking bouts; and that they could be murderous is signified by a passage in Monstrelet, in which the murder of a distinguished prisoner was rumoured to have been effected by a blow on the head from a pewter pot. The sign of the pewter flagon or dish is still a favourite with innkeepers in France.

Neither did princes wholly discontinue the use of pewter plate with the close of the 14th century. Thus in 1401 Isabel of Bavaria added nine dozen of dishes and 23 dozen of porringers to what she already possessed; while she caused another 30 dozen to be delivered to the Hôtel St. Poi; and in 1422 Jean Goupil, of Tours, furnished 64 dishes and 158 porringers to Charles VII. This may have been intended for use in the kitchen, as in the case of the magnificent Jacques Cœur, 1453, who provided pewter for his workpeople. The very complete inventory of Sir John Falstolfe, in 1459, which comprises no less than 19,000 ounces of plate, at all events includes no pewter, so that in this century

wealthy magnates must have disdained its use. When Charles of Burgundy was defeated, his plate was of silver and fell into the hands of the Swiss, who broke it up and sold it in the belief that it was pewter.

To illustrate its extensive use among the middle classes during the 15th century, it must suffice to cite a progress of Buschius of Hildesheim, about 1470, to inquire into the condition of the convents of Saxony. In the Holy Cross of Erfurth he found 150 amphoræ, 70 cups, 12 jugs, 33 porringers; at St. Cyr, 200 amphoræ, flagons, and tankards: in the White Ladies of Erfurth, 41 amphoræ, 10 porringers, 4 flagons; and in the Cistercians of St. Martin, 150 amphoræ, flagons, and porringers. A curious record of "Synt Stephnes in Colman strete," of the year 1467, mentions "3 pair of cruets, 22 dishes for the sepulchur, 2 for the pascal, and 1 on a stokke befor Synt John in the church." In France we find even a blacksmith in possession of 12 pewter plates and a tankard.

It is probable that 15th century pewter was intended for use and not for display. The small prices for which it was melted and recast seem to settle the question.

The 16th century introduces us, for the first time, to a pewter *de luxe*, apart from ecclesiastical pewter, which was probably always decorative. In this century the bourgeois displayed his pewter on the buffet with the same pride as the nobleman displayed his silver and gold; and there is no doubt but that art was lavished upon it as it never had been before; even the great nobles did not disdain to possess the larger, and, as we may suppose, the handsomer pieces. In 1497, the Countess of Angoulême had tankards and ewers of different sizes, to the weight of 116 lbs.; the Duke of Bourbon, in 1507, possessed three pitchers and three ewers; the Duke of Bourbonnays, three quart flagons, three pitchers, and two ewers. However, the esteem pewter was held in will be apparent, when we look at the work itself; for the moment, I merely wish to illustrate the extent to which it was used among various classes.

Princes still continued to use it for their households. In 1507, the Duke of Burgundy's inventory comprised the modest service of 32 plates, 32 porringers, and a mustard. The Archbishop of Canterbury, in 1575, possessed 18 score and 10 lbs. of pewter vessels in the kitchen, in jugs, basins, porringers, sauce boats, pots, and 19 pewter candlesticks; also pewter measures in the wine cellars, and eigh

pewter salts in the pantry at Lambeth, and two garnishes of pewter, with spoons, at Croydon. Lord Northampton's kitchen, in 1614, was furnished with 300lbs. weight of pewter, which, in great houses in England, was put under the charge an officer, called the "yeoman of the ewerie." Pewter is seldom absent in the 16th century from middle-class inventories. To take one example from Paris: a mercer, in 1572, bequeaths to his son six plates, two-eared and two deep, and four shallow porringers, three large dishes, three sauce boats, a mustard, salt, a couple of basins, water pitcher, and pint pot. One provincial example, the inventory of Pierre de Capdeville, merchant of Bordeaux, in 1591, must suffice, especially as it is very complete. It contains a variety of measures, and a number of jugs, some very large, probably for holding, transferring, measuring, and selling wines; then for household use a ewer, 2 flagons, and 2 *ollieres*; 6 great dishes, *du grande molle*; 13 dishes, *du deuxième molle*; 1 *du tiers molle*; 8 *du petit molle*, whatever these qualities or sizes may mean; 36 round plates, 14 eared porringers, 7 sauce-boats, 2 large *gardelles*, and a quantity of old pewter, weighing 120 lbs., besides a shallow basin, "silver fashion," to wash hands, and its water-can, or rather cistern, *de belle facon*. The use of the terms, "silver fashion" and "handsome fashion," evidently denote artistic objects. Coming to England, Harrison, whose work was written from 1577 to 1587, states that it was usual for the great nobility to have drink served in silver vessels, "or, at leastwise, in pewter." "Likewise, in the houses of knights, gentlemen, merchantmen, and some of the wealthy citizens, it is not geson [*i.e.*, uncommon] to behold generally their great provision of tapestry, Turkey work, pewter, brass, fine linen, and there costly cupboards of plate." Old men yet dwelling in the village tell of the exchange of vessel, as "of treen platters into pewter, and wooden spoons into silver or tin." For so common were all sorts of treen stuff in the olden time that a man should hardly find four pieces of pewter (of which one, peradventure, was a salt) in a good farmer's house. But now a farmer will think his gains very small if, towards the end of his term, he cannot have "a fair garnish of pewter on his cupboard," "a bowl for wine (if not a whole neast), and a dozen of spoons to furnish up the suit."

It is, on the other hand, remarkable how

very little pewter was seized by Henry VIII. when he despoiled the monasteries, some of the inventories of which are so minute that its absence is pretty assured. Ludlow Priory had only three pewter platters and fayre lavers of tyne, and three old pewter plates; Burton-on-Trent, a ewer and basin in the buttery; Balsall, three tyne candlesticks; and Whitefriars at Newcastle, a lavetarye of tyne and lead in the cloister. An extract from the parish register of the Waltham Abbey Church shows that a pewter chrismatory was purchased in 1554 for 3s. 6d., and a pix for 2s. Thefts of pewter being common in this century, severe laws were enacted, and on the 30th January, 1599, a pavior was hanged at the gate of Paris for stealing a couple of pewter platters from a tavern.

In the 17th century, pewter vessel or plate was still less in use among the nobility, except that certain large and artistic pieces were tolerated or sought after. The Duke of Bourbon, 1660, had a large flagon holding a bucket full, and in 1664 there was a great pewter ewer for water in the Chateau de Turenne. Pepys, who was nothing if not in the fashion, in his diary for 1667 says, "Thence to the pewterer to buy a pewter sisterne, which I have ever hitherto been without," from which we may understand that this was an essential possession to persons of quality. The extent to which it was out of fashion for the table may be gathered from the fact that when the nobles of France were obliged by Louis XIV. to sell their silver, they showed a marked repugnance to going back to pewter; and in the provinces it was painted, lacquered, and gilt to disguise its, by that time, humble exterior. The Grande Mademoiselle writes, recounting her arrival at Nanteuil, in 1656, that she supped well, but indeed on dishes of pewter. To the middle classes, however, it was as indispensable as crockery is to us now. The French inventories illustrate its use, and contain the names of a number of objects of which I cannot discover the equivalents. The inventory of the domain of Chate-lard, 1672, contains the mention of pewter forks as well as spoons, and vessels with covers. That of the Chateau of Montpipeau, 1692, totals to 650 lbs. of pewter vessel, estimated at 10 sols the pound. Quite an extensive use was made of it in the Court of Louis XIV. for such purposes as *pots de chambre*, *chaises percées*, baths, and other utensils of like nature. In the last century pewter wares were largely advertised, Renard of Troyes

boasting, in 1760, that his work was as handsome, and had the contours of silver; and in Paris such new-fangled items in pewter were trumpeted abroad as popular coffee pots, economic lamps, filters, fountains, syringes, &c. A fire which destroyed the Paris Jesuit establishment at this time melted 10,000 lbs. of pewter vessels.

This brings a sketchy and somewhat tedious history to a close. It gives however, I hope, and for the first time, a tolerably clear idea of the use of pewter in the past.

The next point is the history of the pewterer's craft.

There is little difference between the crafts of the blacksmith, whitesmith, silversmith, brazier, and pewterer, except in the materials they respectively use. All alike were under stringent regulations in the Middle Ages, but none more so than the pewterer. The earliest descriptions of one of their corporations is that by Etienne Boileau in the middle of the 13th century, who tells us that the pewterers of Paris were separated into six classes—the potters, toymakers, nailmakers, lorimers, and makers of buckles, &c., for hats. The potters numbered about twenty, and were under two wardens, and controlled by nine articles, not differing much in effect from those imposed on the London pewterers in 1348 by Edward III. Apprentices and approved workmen might enter the corporation free of toll, as long as they were known to be law-abiding, while there were no restrictions as to the number of apprentices and assistants that might be kept. It was strictly forbidden to work at night, artificial light being considered insufficient to produce good work by, and no work was allowed on festival days, unless public fairs were being held. For the use of unauthorised alloys a small fine was imposed, as well as loss of material; and leaden imitations of pewter were equally punishable. The guildsmen, unlike the Cornish stanners, were subject to ordinary taxes, and, save in the case of the wardens, to serve on the watch until the age of 60. The commencement of their great increase in numbers is shown in an imperfect list of Parisian craftsmen, eighteen wood potters disappearing between 1292 and 1300, and apparently making room for eight potters of pewter. Not long after, in 1304, in France, the State exacted a premium or entrance fee from all admitted to the guild, except the sons of masters. It was not until the reign of Louis XIII. that Paris pewter was ordered to be stamped.

The pewterers of Paris chiefly lived with the silversmiths about Notre Dame and the Palais de Justice, and on the Grand Pont; but the silversmiths, in 1545, at all events, were prohibited from working in pewter, since in that year some found in Richer's possession was confiscated. It was not till 1650 that permission was granted to gild or silver the baser metals, and then they were required to be specially marked. A curious and prudent edict of Louis XIV. disallowed the use of all plate but pewter to generals in the army, but even these outfits could be costly, that of the Duc de Luynes having amounted to 2,000 livres.

Bruges, however, was, from time immemorial, the great dépôt for English tin, and its potters were making porringers and flasks of pewter long before 1303. An immense use seems to have been made of pewter bottles, and in the "*Livre des Mestiers*" of Charles V. of France (1457) we read of "*bouteilles d'estain*," &c. Moreover, the leather bottles of that date were imported from England, or made in France "*à la mode d'Angleterre*." The Bruges pewter "*pintiers*" furnished eight sergeants to the militia in 1376, and those of Ghent thirteen in 1356. After the battle of Gavres the Ghent pewterers decorated their guild-house with grey cloth and coats of arms, and carried 13 torches to honour the Duke of Burgundy. There were pewterers in Mons in 1353, and in 1467 their pewter was marked "*fin*" with a crowned hammer, but if spun the mark was a small castle and the arms of the town. Fine English pewter, manufactured out of the town, but brought in for sale, was stamped with a rose and crown. The Liège marks are quite as ancient and were an angel and balance for first quality, a crowned rose for the middle, and a fleur-de-lys for the inferior. The beauty of the pewterer's marks everywhere is quite remarkable. At Ath, the Corporation headed the processions in 1328, and we find it only second in importance at Namur, in 1429, when the Dukes of Burgundy succeeded to the possessions of the Count of Flanders.

A pewterers' guild existed prior to 1369 in Rouen, when Royal letters were given, fixing the exchange value of new for old metal, and in 1454 their papers were carefully arranged and locked in a chest. In Poitiers a municipal decree against fraudulent alloys was issued as early as 1333. Enactments, with the same object, but of later date, are preserved in other towns, and their stamps are described. The

were generally the City arms with letters to denote quality. The Duke of Burgundy, in 1478, established guilds of pewterers in many of his principal towns, to prevent the use of fraudulent alloys; when, in the grape country, it was enjoined that new members were to regale the guild with copious libations on their admission.

Germany was, perhaps, not far behind in pewter work, for it was enacted in Augsburg in 1324, that the sworn masters must visit all workshops and stores four times yearly, to satisfy themselves as to the purity of the alloys, when, if any inferior or slovenly work is found, the objects are to be destroyed and a fine levied. Sebaldus Ruprecht soon after, gave to pewter the colour of silver, and was renowned for the fineness of his work. In Nuremberg the potters formed the leading corporation, and by the latter half of the 16th century there were 44, and a little later, no less than 56 masters. The marks were a crowned eagle for beaten, and for unmixed English tin, and for the same alloyed with a maximum of 10 per cent. of lead, a half eagle and two flails on a shield. Many Nuremberg pieces, however, are found marked with a rose. From 1579 no silversmith was allowed to work in pewter, nor might a pewterer work in any other metal.

Little pewter ware seems to have been made in Italy, and not a great deal in Spain; while Switzerland and Holland produced it rather largely.

The history of our own Pewterers' Company is now being written by Mr. Charles Welch, F.S.A., and the following particulars are gathered from articles contributed by him to the *City Press* a couple of years since. The earliest record is dated 1348, when ordinances were granted by the Mayor and Alderman upon the petition of the makers of pewter of London. They were framed to defeat fraud, and maintain the good reputation of English pewter, and appear to be based on the Paris ordinances which I have just described. The only additional matters of importance are, that two qualities of pewter were permitted: the first called *finite pewter*, contained as much brass as the tin "of its own nature will take." Of this quality were made esuelles or porringers, salts, platters, salvers, pitchers squared, cruets squared, chrismatories, and other things that are made squared or ribbed. The second quality consisted of tin with about 20 per cent. of lead, used for vessel, otherwise pewter plate. Further, pewter goods might not be

brought into the City for sale without being assayed. Some new ordinances being added in 1438, without authority of the Mayor, were annulled, and only allowed afterwards upon solemn petition. In 1430 the exact weight of all the principal vessels made was fixed, to prevent light weight being sold. In 1444 the warden acquired the right to a fourth part of all the tin imported into the City, and to search and assay it. An income was made up of this quarterage, admission fees of brethren of the craft, and bequests. The company received a charter from Edward IV. in 1473 confirming their powers of search and assay, and in 1503 an Act of Parliament was passed prohibiting the sale of pewter off the premises of a pewterer, except in an open fair or market, and ordering it to bear maker's marks. A little later the wardens were empowered to make search for defective ware five times in the year. Statutes of Henry VIII. forbade imports of pewter on pain of forfeiture, and no foreigner was permitted to practice the trade in any capacity here, nor were English pewterers allowed to exercise their calling abroad under pain of alienation. Further charters were granted under Mary, Elizabeth, James I, and Anne. Under the latter each member was obliged to deliver to the master for the time being a private mark or touch, to be impressed on a plate kept in the company's hall, with which all his wares were to be marked under a penalty of 40s. All defective and unmarked pewter to pay 1d. per lb. A quaint and salutary enactment was, that all pewterers applauding or boasting of their goods and disparaging those of other pewterers, or improperly enticing the customers of another pewterer, were to pay a fine of 40s. In 1555 it was agreed that anyone buying metal by night, or of tylers, labourers, boys, or women, should, if it proved to be stolen, be dismissed the Company and brought before the Lord Mayor and Aldermen for further punishment. From these brief extracts it will be seen that the records are remarkably perfect and interesting. The touch plates, of which I am enabled to show a series of reproductions, through the kindness of Mr. Welch, are extremely curious and will be valuable when dated; though unfortunately those recorded for the first hundred years have not been preserved. The oldest here represented is dated 1640, and the latest 1824. The practise of the Pewterers' Company, whose jurisdiction eventually extended over England, was that the makers should stamp their own

ware at home; whilst the Goldsmiths' Company mark all silver at Goldsmiths'-hall with their own marks for the year. To prevent a common imitation of the latter marks, the pewterers were ordered, in 1635, to strike but one stamp on their pewter, unless the customer desired to have added his own mark or arms.

Respecting the celebrated Belgian and Dutch *steimerie*, I have as yet learnt but little. Those wishing to join the craft had to present themselves to the "rewards," who handed them the freedom and a diploma. The Netherland interiors, so frequently delineated in the 17th century, introduce most exquisite, and evidently faithful copies, of pewter vessels, from which we can form the most exact idea of their admirable forms and decoration. In our Museum, however, we have only one specimen of reputed Dutch manufacture, a small-eared porringer, decorated with a Tudor rose in the bowl, and undated.

This brings us to the concluding portion of our history. We have now traced the rise and decline of the use of pewter, and also the regulations under which it was manufactured. It only remains to realise what the work was like.

Scarcely any early work remains, owing, as we have seen, to the slight cost of melting and recasting the metal. In France, the peasants still regard their own pewter with superstitious veneration as the metal *pur et sain par excellence*;" and they cannot be induced to part with it, either for money or in exchange for new, though they will readily stand by and see it recast by the perambulating *rétameur*, who carries his furnace on his back, and his moulds in a sack. The very small price allowed for re-casting even the royal pewter, the particular forms of which were not permitted to be sold to others, shows that "fashion," as the silversmiths call it, counted for so little, that it must have been all but absolutely plain. But this was certainly not the case with pewter for sacred use; if we may judge from the Gloucester candlestick and the chalice which we have illustrated, it was highly decorative; in fact, many of the minor objects that have been preserved, such as buckles, buttons, nail-heads, tokens, pilgrims' signs, inkstands, &c., show that it was treated with fine feeling.

In France it is possible that pewter was treated artistically by the 14th century, perhaps much sooner, since Jean de Jeandun writes in 1323, that there were many chasers of vases of gold, silver, *pewter*, and bronze on the Grand

Pont; and Guillebert de Metz, in 1407, tells us that a pewterer dwelt facing the palace, who was a worker of marvellous vessels. The inventory of a Rouen pewterer furnishes a valuable list of tools, moulds, &c., in use in 1402, and an inventory of only a year later mentions two pairs of bronze moulds and wooden chucks, for casting and turning apparently some particular pattern of plate and porringer. A seizure of goods at Nismes in 1438 illustrates a pewterer's stock in trade, which consisted of a score of platters, six

FIG. 3.



Cymaise, 17th century. (Havard.)

dozen dishes, a few others with handles and ears, some covered and uncovered pint pots, a few water pitchers, and other odds and ends. The trade by this time had reached larger dimensions in France, no less than 116 names of French pewterers of the 15th century having been collected by Bapst. The ewers, salvers, and flagons used to decorate their buffets by the middle classes, and even at times by the nobles, must necessarily have been works of art. We constantly read of pewter *de belle fasson* and *fasson d'argent*, in the inventories and accounts so industriously collected by Havard for his Art Dictionary. For example,

in 1389 the Bishop of Rheims wills 18 dishes great and small, 48 porringers, a square measure, 2 square quart pitchers, 2 round *silver fashion*, 1 square pint, 2 measures of 3 chopines *silver fashion*, &c. The municipal accounts of Amiens show many such payments, as to Pierre Hemioron, pewterer, for 4 small ewers of fine pewter, *silver fashion*, 1508-9. A small pewter ewer and basin, holding about 3 pints, is described, in 1521, as a *lavabo de belle fasson* to wash hands. That silver designs were really used for pewter seems to follow, from an extract taken by

FIG. 4.



Ewer, French Renaissance. (Havard.)

Havard from the "Comptes de l'Argenterie," for 1470, when drawings and patterns of cups in pewter and clay were purchased from J. Chennau and G. Poissonnier, goldsmiths of Tours, and Lambert de Sey, goldsmith of Amboise. Among the most decorative objects was a vessel called a *cimaise* (Fig. 3*, p. 637), destined to hold the *vin d'honneur*, of an elongated form, with cover and handles. Later on similar flagons were given as prizes for shooting, especially in Burgundy and Switzerland. For example, François de Roussy, armourer to Francis I., received a pewter work of art as a shooting

prize at Lyons. They were usually embellished with the arms of the town and representations of the weapons used. Artistic interest, however, culminates round the name of Briot, the Cellini of pewter, who was born probably about the year 1550, and lived under Henri II., Charles IX., and Henry III. He was living in 1615, but the date of his birth and death are alike unknown, though enough has come to

FIG. 5.



In the British Museum. Aiguïère or Ewer by Briot. From Bosc's "Dictionnaire de l'Art."

light regarding his life to show that he was really a Frenchman, born in or near Besançon, and a medallist and die-sinker by profession. One of the oldest of the works, in the style of François Briot, is the salver, of which we have a fine original, lent us by the South Kensington Museum, representing, in relief, the history of Susanna and the Elders. The umbilicus has been replaced at a later date with an enamel, but otherwise the specimen is in good preservation. Germain Bapst very properly considers that this and two salvers representing Diana and Acteon, and the life of Hercules,

* Permission to use the illustrations from Havard's "Dictionnaire de l'Aménagement" has been kindly granted by the Maison Quantin, Paris.

and a ewer, perhaps belonging to one of them, are too crude to be by the hand of the great master. There is also in existence a wall-fountain by one of the same unknown hands. The *chef-d'œuvre* indubitably worked by Briot is the superb ewer and dish representing Charity and Temperance, a description of which is superfluous, as we have an original before us of this famous and oft-described, but not over-praised, piece. The best examples are signed "Sculpebat Franciscus Briot" on the umbilicus, with a portrait. It has often been reproduced in silver at different dates, and Palissy moulded a copy of it somewhere about the year 1580. The patterns for the reliefs appear to have been made to the order of a pewterer and sunk, as dies are, in metal or stone, not embossed; and the pewter was cast in bronze or stone moulds, and required no touching up, except that the plain mouldings were turned on a wheel. The ewers (Fig. 5, p. 638), however, are believed to have been cast in several pieces and soldered together.

The fine specimen of the salver or basin, signed, with the portrait of Briot, lent by the South Kensington Museum, is in admirable

preservation. The British Museum possesses

FIG. 6.



Tankard by Briot, in the British Museum. Bosc's "Dictionnaire de l'Art."

one of the covered tankards (Fig. 6), with three

FIG. 7.

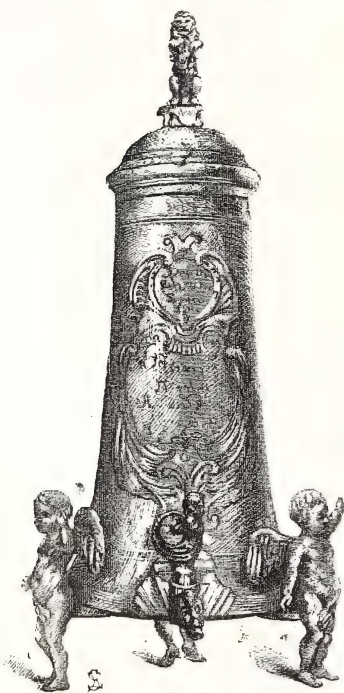


Basin in the Louvre, made for Henry III., the reliefs by Briot. (Hav: rd.)

medallions, representing "Patience," &c., signed F. B., and evidently an authentic work of the great artist. The Louvre collection have some superb dishes (Fig. 7), probably for baptismal purposes, made for Henri III., with Briot medallions. These are almost the only objects by this master, and, exquisitely fine as they are in detail, they are open to the criticism of over elaboration.

The scarcely less celebrated Gaspard Enderlein was born in Bâle, worked in Nuremberg, and died in 1633. He was much esteemed by his contemporaries as an embosser and caster of figures, a die sinker, and as the first to cast hanging chandeliers of pewter. A singular

FIG. 8.



Cistern of the 17th century work. (Havard.)

fact, which has led to much controversy, is that Briot's celebrated *chef-d'œuvre* is often found inscribed "Caspar Enderlein sculpebat," with his portrait, and dates like 1611, which are many years after its first production, as proved by the fact, if by nothing else, that Palissy moulded from it. Specimens thus signed are in the British and South Kensington Museums.

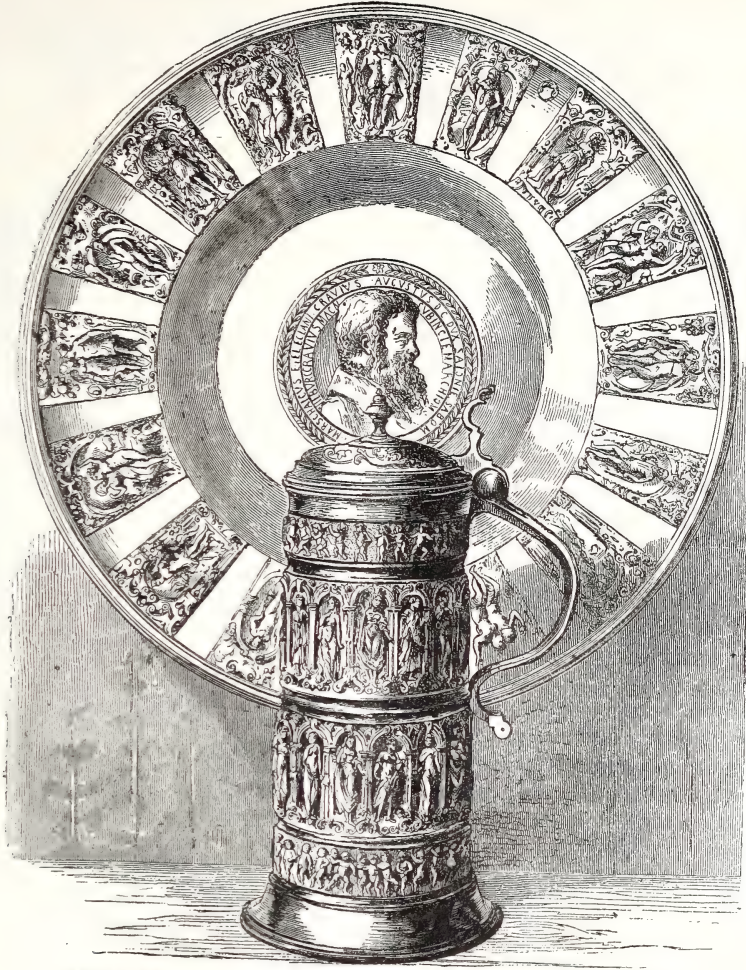
True German specimens are much coarser in the modelling, like one in the Sauvageot collection, signed M. H., for Martin Hurscher (Fig. 9), in which a medallion of Augustus of Saxony is inserted, and they usually bear

Nuremberg marks. From their similarity they must have proceeded from few studios.

The British and South Kensington Museums possess a number of the small German plates, dating from 1619 to 1650, with medallions and arabesques in relief. Fig. 10 represents one in the British Museum, dated 1619, which illustrates the story of Adam and Eve. Another, dated 1654, bears equestrian portraits of Ferdinand III., and the electors (Fig. 11); and a third (Fig. 12) has portraits of the emperors. For the most part, however, their decorations are religious subjects, and they almost always bear Nuremberg stamps. We are also enabled, by the kindness of the Maison Quantin, to illustrate three German pewter tankards of the 15th, 16th, and 17th centuries from Havard's "Dictionnaire de l'Ameublement."

Art, if not of a high quality, was expended upon pewter long before the rich relief work, which we must consider to have been introduced in France and imitated in Germany. The name of Carel, a Nuremberg pewterer or *ziungiezer*, is recorded in 1324; and by the end of the 14th century, Sebald Ruprecht was renowned for giving to pewter the colour and appearance of silver, and for the fineness of his work. Martin Hurscher, who died in 1523, at the age of 83, executed in pure pewter everything that a silversmith could make in silver. His tin, purified and alloyed, equalled in quality and brilliancy that of England. He not only made pots, vessels, and plates, but candelabra, bénitiers, bowls, basins, and statuettes. Neudörffer and Doppelmayer were his friends, and the latter bears testimony also that he was very clever, and executed the works of silversmiths quite as well as they did themselves, in a special pewter, which yielded in nothing to the English. These flattering testimonies to the quality of our English ware are, by-the-bye, far from rare. Doppelmayer also relates that Melchior Kock, pewterer, carried out his work with great care; he discovered a particular material by which he made bowls, dishes, and plates look as if gilded with the best gold. The art perished with him in 1567. Hans Lobsinger, who died in 1570, made hollow figures in tin and wax, and was very clever, being able to render the metal as soft as paste, while he stamped and modelled it, afterwards restoring it to its original hardness. His quality, likewise, equalled the English. By ordinance, in 1575, everyone aspiring to be a master pewterer was obliged

FIG. 9.



Salver and Flagon, with Medallion Portrait of Augustus of Saxony. (Havard.)

FIG. 10.



German plate, dated 1610, and signed G. M., in the British Museum. (Havard.)

FIG. 11.



German Plate, with Ferdinand III. and the Electors, 165 (Havard.)

to make, within the space of a week, a quarter on a foot, a dish about 4 lbs. in weight, and a pitcher holding four or five pots, bearing a written snatch or proverb. Eobanus Hessus, poet of Nuremberg, speaks of the numerous

FIG. 12.



Plate in relief, German, 17th century. (Havard.)

foundries of pewter, and the quantity of workmen who manufactured all kinds of objects in it. Hartman Schoper, in his "Treatise on Industries," 1573, makes his pewterer say, "I make vases of all sorts of molten metal. I

FIG. 13.



Tankard, end of the 15th century. (Havard.)

produce the bowls with out-turned rim, the ewers, and other kindred objects, with pewter, which I melt in my furnaces. You will find with me, according to your tastes, the sparkling bowl, the broad craters, the

flasks, and the tankards, in short all that can make your guests merry and taste the goodness of wine." Three grand flagons belonging to the close of the 15th century are in the Museum of Breslau, of which I give an illustration

FIG. 14.



Tankard, 16th century. (Havard.)

(Fig. 16, p. 643) from the *Revue des Arts Decoratifs*.

These, like the fine salver belonging to the South Kensington Museum, with a border of historical subjects broken up with medallions

FIG. 15.



Tankard, 17th century. (Havard.)

of equestrian figures, and a female holding two music horns in her hands in the centre, have a sort of incised decoration, exactly as if they had been cast from old wood printing blocks. The salver, which is dated 1567, might other-

wise, as to the outline and arrangement of its decoration, have served as a prototype to the embossed salvers which preceded Briot's.

Side by side with these elaborately decorated works were made humbler articles with incised ornament, such as pitchers, porringers, plates, bowls, flagons, salts, and candlesticks. They are quite distinct from silver-smiths' work, as in Nuremberg the latter were not allowed to meddle with pewter, some candlesticks cast by Peter Schmitt in 1579

FIG. 16.



Flagon made for the Bakers' Company, dated 1497, decorated with religious subjects. In the Breslau Museum.

having led to this prohibition, and also to pewterers being forbidden to work in brass or copper, and the makers of moulds from taking casts from them. The fine series of guild cups in the South Kensington Museum, are of much later date, but more pleasing and appropriate in general design. Those of the United Carpenters and Masons, and of the Millers and Bakers, are dated 1695, and of the Shoemakers 1704; while a wedding anniversary cup is of 1684. The finest and most suggestive piece I have ever seen, however, is the noble flagon inlaid with brass or auricalchum

belonging to Mr. Gurney, which he has kindly lent to the Museum, and allowed to be exhibited here to-night.

We have, unfortunately, no recognised English pewter to vie with that we have just been describing. Harrison, with pardonable exaggeration, perhaps begotten of the intensely patriotic feeling in Elizabethan days, says that "in some places beyond the sea a garnish of good flat English pewter of an ordinary making (I say flat, because dishes and platters in my time begin to be made deep, like basins, and are, indeed, more convenient both for sauce, broth, and keeping the meat warm), is esteemed almost so precious as the like number of vessels that are made of fine silver, and in manner no less desired among the great estates, whose workmen are nothing so skilful in that trade as ours, neither their metal so good, nor plenty so great, as we have here in England." Again, he remarks that our pewterers "are grown into such exquisite cunning that they can in manner imitate, by infusion, any form or fashion of cup, dish, salt bowl, or goblet, which is made by goldsmiths' craft, though they be never so curious, exquisite and artificially forged. Such furniture of household of this metal as we commonly call by the name of vessel is sold usually by the garnish, which doth contain 12 platters, 12 dishes, 12 saucers, and those are either of silver fashion or else with broad and narrow brims, and bought by the lb., which is now valued at sixpence or sevenpence or eightpence. Of porringers, pots, and other like, I speak not, albeit in the making of all these things there is such exquisite diligence used, I mean for the mixture of the metal, and true making of this commodity (by reason of sharp laws provided in that behalf) as the like is not to be found in any other trade. I have been also informed that it consisteth of a composition which hath 30 lbs. of kettle brass to 1,000 lbs. of tin, whereunto they add 3 or 4 lbs. of tingle; but as too much of this doth make the stuff brittle, so the more the brass be the better is the pewter, and more profitable unto him that doth buy and purchase the same." The most remarkable piece of English pewter that I have seen, is the South Kensington Museum salver engraved with the royal arms and garter in the centre, and with lightly incised branches of oak, roses, tulips, and sun on the rise. It is inscribed, as you see, "Vivat rex Carolus Secundus Beati pacifici 1662." The ornament, unlike that of all the German examples, is engraved, not cast. There are on exhibition

a variety of other objects of English pewter work of great interest. Among them I would especially call your attention to the platter engraved with homely incidents, of the time of Hogarth, with rococo borders, lent by the Pewterers' Company. The South Kensington Museum has recently been fortunate enough to acquire a service decorated with engravings from Hogarth.

FIG. 17.



Fint Measure, 17th century. (Havard.)

Now, as to the future of pewter, we can scarcely flatter ourselves, or wish that the march of progress is to be reversed, and that our beautiful pottery, porcelain, and glass will be laid aside. Civilisation will no more consent to dine off pewter platters again, than off wooden trenchers. It may furnish, however, once more, the larger vessel or plate for the tables and buffets of those who cannot afford, or dislike the ostentation of silver, and despise electro-plated shams. For presentations, again, how infinitely more desirable those noble pewter tankards and flagons before us are than electro-plated goblets and mugs, or even silver of shopkeeper's patterns. Then, merely as part of its decoration, a wainscoted room seems no more completely furnished without the decorative glint of pewter, than without the harmony of blue and white or grey pottery. Again, there are the beautiful cisterns, or wine-coolers, which Pepys could not do without. Something good might be done with pewter bas-reliefs for cabinet work and inlays, as in France. Inlays of pewter in the fashion of Boule work were made in the 15th century, and rafters and cornices in the royal palaces

of France were decorated with pewter ornaments, while in Germany entire doors were sometimes wholly covered with stamped and painted plates bearing armorial devices. Some rare and very beautiful coffers of the 14th century also exist, entirely decorated with pewter ornaments. What, again, could excel pewter for flambeaux, lamp-stands, candelabra, candlesticks, appliques for the wall, and pendant lustres. They could be inlaid with brass or copper, touched with niello, incised like sgraffito, and filled with black oxide, or heightened with enamels or subdued earthenware.

It seems our fortune to follow in the matter of art revivals in the wake of the French. In lead and zinc work, in good iron casting, in bronze, in forging iron, in tin and pewter, and in enamelling, they have preceded us by quite ten years at the least. They have never in fact, as we have, ceased to recognise the beauty of the industrial master pieces of their own country of preceding centuries; and hence their art revivals have been more rapid and more consistent than ours. Moreover the French nation is relatively largely leavened with artistic appreciation, which in our country is still almost as rare as gold grains in quartz. But if the French still stand first and almost unrivalled in art, we quite as certainly stand second, and there are indications that we may soon run them close. What we require, and what a great Society like this might do somewhat to accomplish, is the raising up of an intelligent artisan class with artistic feeling; which our educational outlay must be preparing for, in place, to some extent, of the operative class of the ignorant past. It is difficult to contemplate with patience the retrogression of skilled and industrious men, who have been highly instructed at school into the ranks of trades' unionism, whose tendency is to reduce the gifted and the automatic to one dead level—a happier and more prosperous one, no doubt, yet dull, and machine-like. Forced into ranks, where the majority rules and the minority has no rights, there is but one outlet for exceptional energy and skill, agitation, which is the destruction of good workmen. This might be checked by the revival of guilds of skilled craftsmen, with as complete freedom of action as ourselves. The part such a Society as this might take in guiding and helping such a movement is not for me to point out, but, however valuable the advice and sympathy of other classes may be, it can only be brought about by the actual

workers in the world who come in contact with the rising artisan, and who are familiar with his requirements and prejudices.

The author wishes to express his deep obligations to Mr. Thomas A. Simmonds, the Director of the Arts' Company of Derby, for the loan of the lantern slides, which rendered the metallic look and details of the objects with fidelity and precision. This company has with great spirit expended a large sum in photography, and producing lantern slides of a vast number of art objects in this country, especially of those in the South Kensington Museum. Also to the Director of South Kensington Museum, for the matchless collection of pewter lent in illustration of the paper, and to Mr. Gurney, for permitting his unique flagon to accompany it. To the Master of the Pewterers' Company, for the fine display of old English pewter belonging to the Company, and Mr. C. J. Shoppee, F.S.A., for the interesting collection of old pewter, admired for its perfect condition, and to Lieut.-Colonel Lambert, for some valuable specimens. Also to Mr. Henry C. Eyres, for specimens of English pewter table ware; and to Messrs. Brown and Englefield, for old and new price-lists, moulds and specimens in illustration of the manufacture of pewter.

DISCUSSION.

The CHAIRMAN said they must have all listened with great interest to this very learned and valuable paper. With regard to the analyses of the pewter in the South Kensington Museum, very little progress had been made, but the few specimens submitted to examination proved to be nearly pure tin, 99·0 per cent., he found in three platters, the exact date of which he did not yet know. There was no doubt that the presence of a small amount of lead gave, as in the case of bronzes, a certain velvety patina to the pewter; but, on the other hand, if the material was to be used for "spinning," a little anti-mony was necessary. He hoped they would soon see a great revival in the use of pewter. The use of flagons and other vessels had not been prohibited, he believed, since early times by the Church, but there were, as far as he knew, no chalices, or only one, in a little church recently built not far from Guildford, which, though it was for a poor community, they were endeavouring to make as beautiful as possible, and they had a pewter chalice of great delicacy and beauty; and there was no reason why this fine material should not be more used for church work. He almost regretted that the figure at the top of the fountain in Shaftesbury-avenue was not in pewter instead of aluminium, though it might be that it

would be too heavy for the attitude which Mr. Gilbert had thought fit to give to it; but it would have been more interesting and more likely to take a fine patina than aluminium, as far as he could judge from the few specimens of the metal which had yet been subjected to the London atmosphere. There were some very fine specimens of pewter recently exhibited in the Grafton Gallery, amongst a great deal which was remarkably bad, principally inlaid work in cabinets. It had been suggested that, in many cases, men like Briot, the son of Nicholas Briot, one of the greatest medallists, persistently made patterns, as it were, of gold and silverware in pewter, using this material much as a sculptor might use clay for his preliminary models. At any rate, there were accounts in the Rouen Mint of works executed in pewter, being subsequently cast in silver.

Mr. W. GOWLAND said he might be able to add a few remarks on the use of pewter in the far East, China, and Japan, but he must first refer to a difficult piece of research by the Chairman into the constitution of alloys, because it had a distinct bearing on the patina which the Japanese gave to their pewter vessels. Professor Roberts-Austen had shown, by means of the thermo-electric pyrometer, that when an alloy was in the act of cooling several definite alloys, in which the molecules of the metals were differently grouped from those of the mass, fell out at definite temperatures, so that the solidified metal did not consist really of one alloy, but was a mixture of several, more or less regularly diffused throughout its mass. This property, which was specially marked in the case of pewter, had been unconsciously taken advantage of by the Japanese in giving a patina to their old pewter tea-jars. These jars had a very fine surface, consisting of a dark grey patina, over which darker patches were scattered, forming a clouded pattern. Some of these old jars were very valuable, more so even than a silver jar of the same dimensions, especially when this mottled appearance was well developed, and uniformly distributed over the surface. In Japan, pewter articles were never polished after they left the hands of the maker, the sole treatment was to rub them over from time to time with a cotton or silk cloth, the result being that as they got old the surface became coated with a fine grey patina of two tints, the lighter forming the ground, over which was scattered dark patches, which produced a beautiful mottled effect. These were undoubtedly due to a grouping of the metals in different proportions, or in a different manner, to that which existed in the lighter parts. The action of the air and the gentle rubbing, in fact, rendered visible one, or perhaps more than one, of those alloys which fell out in cooling. This appearance was not visible on any of the specimens now shown, and he thought this was due to the vigorous polishing some of them had received, and in other cases to a neglect of any rubbing. He had analysed

the cover of one of these old Japanese tea-jars, dating from about the middle of the 18th century, taking two different parts, and, of course, they showed slightly different results, again proving the segregation which he had referred to. One part of the lid contained 80·48 per cent. of tin, and 20·02 of lead; the other 77·64 per cent. of tin, and 22·5 of lead; there was only a trace of copper and iron present, and no arsenic, antimony, zinc, nickel, or cobalt. Practically, therefore, Japanese pewter did not differ greatly from ordinary English pewter. So far as he had examined the pewter of the East, he always found that it consisted of tin and lead only; in old days they might have used antimony, but certainly not recently. In China, the use of pewter went so far back that there was no record of its introduction. Of its composition they knew nothing, but the mediæval Chinese pewter probably contained an excess of lead, because it was stated in the "Hon-zo-ko-moku," an old treatise on natural history, and *materia medica*, published in the 16th century, that wine—meaning a liquor prepared by fermenting rice—which had been kept in pewter vessels, acquired poisonous properties. The author attributed this to arsenic, saying it was well-known that arsenic generated itself in the space of 200 years, but after the lapse of another 200 years, by the action of the feminine principle of nature, it was converted into tin. When, therefore, these vessels were poisonous, the tin which had been used in their manufacture consisted of a mixture of arsenic and tin, an insufficient time having elapsed for the complete transmutation of the former into the latter metal. He added that when the tin so formed was acted upon by the male principle of nature it was converted into silver, but he did not specify the time required for this transmutation. He thought it highly probable that lead, and not arsenic, was the cause of the poisonous properties referred to. In Japan the first record of the use of pewter was during the reign of the Empress Shotoku, A.D. 765 to 770, when vases and utensils were made of it, from tin found in the country, which it was said was better for making pewter than the tin obtained from China, so that this alloy had evidently been in use at a much earlier date. The oldest specimens he had seen were in the ancient treasure-house at Nara, in which the paraphernalia and costumes of the court at the accession of the Emperor Kwammu were placed, when the capital was changed to Kioto, in 784. The specimens he saw there were spoons, resembling very much some of the duller specimens shown that evening, but he found it impossible to get even any scrapings for analysis. With regard to the use of pewter in Japan, it commenced about the 10th century, and was used with mother-of-pearl to inlay some of the finest lacquer work, and also for the rims of the larger boxes of lacquer. You might generally conclude that a lacquer box with a pewter rim was an old specimen. The ornamentation given to the pewter was very rarely *repoussé*—nearly always incised or pierced. In some cases pewter vessels were

entirely coated with gold lacquer. For some of the vessels used at the marriage ceremony, pewter, highly ornamented by inlaying with gold and silver and some alloys of brass and bronze, was occasionally employed; but at present the chief commercial use of pewter was in the manufacture of tea-jars and canisters, and for vase-shaped bottles, which were used in offering wine at the Shinto shrines. It was not much used for domestic utensils, for which wood, pottery, porcelain, copper, or brass seemed to be preferred. Probably the old Chinese belief as to the arsenical origin of tin might have something to do with this limited use of pewter.

MR. PHENÉ SPIERS said he had no knowledge of pewter himself, but meeting Professor Church that day, he asked him if he could give him any information about it, and two things he learned from him might be of interest. He said he had found, in two or three cases, that the fonts in churches which were supposed to be of lead, were really of pewter; one in particular he referred to, near Cirencester, of 13th century design, of which he had made a drawing, showed that in its design it was similar to the work found in 13th century tomb-work in hard stone. He also told him that Chancellor Ferguson, of Carlisle, had lately published a work in which he gave illustrations of chalices and church plate found in the northern province, showing that there still existed specimens of church plate in pewter in the north. In the early part of the paper Mr. Gardner referred to the great cost of the mould for casting pewter, but subsequently he remarked on the facility with which old pewter was re-cast, and the nominal cost at which it was done; and he did not understand how those two facts were reconciled. Perhaps the expensive moulds were for elaborate work, and did not refer to ordinary platters and pots. He should also like to have the word "spinning" explained, as it was quite new to him.

MR. ENGLEFIELD said pewterers in London did very little spinning. It was done on the lathe with a spinning stick, according to the shape of the article required.

The CHAIRMAN said pewter was plastic, just like clay; a disc of the metal was put on the lathe, "spun" at a certain rate vertically, and a hard tool being pressed laterally against it, it followed the tool with as much facility as if it were clay.

MR. HUGH STANNUS desired to express thanks to Mr. Gardner for the interesting paper, illustrated as it was so fully by engravings, lantern-slides, and a fine collection of old and modern pewter-work. He ventured to express his opinion that if anyone were fitted to prepare a text-book on the subject, it would be Mr. Gardner himself, who possessed the practical knowledge, the artistic instinct, and the literary ability; as had been shown in the book on

Iron-work, prepared for the South Kensington Museum. Allusion was made to pewter pots having been used as weapons in brawls, and he thought brass candlesticks must have been used in the same way, for he had collected some, and found they were often out of shape, as if they had been used as clubs. With regard to the use of vessels in a "sepulchre," it might be expected perhaps in this way. In Italy, the recesses underneath the raised choir portion of the church are sometimes furnished with life-size figures, in terra-cotta, on one side a representation of the Last Supper, and on the other side one of the Entombment; and perhaps the pewter plates might find their place as part of the furnishing of the table in the former. He was much interested in the possibilities of pewter, both as a medium of artistic expression, and as a suggestive material for village industries. He asked Mr. Gardner to give his opinion on the various methods of decorating the material—engraving and punching, embossing and chasing, or die-sinking and casting.

Mr. STARKIE GARDNER said he was much indebted to Mr. Gowland for the admirable manner in which he had supplemented the paper, on points about which he was quite ignorant himself. What he said about the patina of pewter was quite new to him, and probably to most people; for he did not know that it was one of the beauties to be looked for in pewter. No doubt, when they were more advanced in the manufacture, and understood it better, they would avail themselves of this property. He was glad to learn that Japanese pewter was tin and lead, as he was in favour of that alloy, rather than tin and antimony or tin and copper. The antiquity of the Japanese and Chinese pewter put ours quite in the shade, as we could not go back farther than about the 8th century, there being amongst the specimens until lately preserved a chalice of the 8th or 10th, and a candlestick of the 11th century. The old English fonts, to which Mr. Spiers referred, had always passed for lead, and had become dark in colour by age and neglect. There were many pewter chalices in the north, especially in Scotland, and he believed they were still made. Re-casting was so cheap, by reason of the enormous demand, as soon as pewter generally replaced wooden platters; and, as thousands of articles could be produced from one mould, the initial cost of the mould was not important. Spinning was a well known operation in brass-finishing, and there were many spinners in London who did nothing else, and some of the products were very beautiful. He was obliged to Mr. Stannus for his suggestion, but he had no inclination to undertake any more text-books; they involved such an amount of research that one or two in a lifetime were as much as should be expected from anyone. Briot's work was all cast; he was a medallist and die sinker, and the dies from which all these beautiful things were produced were sunk in

the usual manner, and the salvers, &c., were cast in the same way as plain platters and pots. He did not remember any specimen of old embossed pewter work, though he did not know why it should not be ornamental in that way. He was much indebted to the South Kensington authorities for lending all their specimens, which would well repay examination. There was a very fine specimen belonging to Mr. Gurney—a covered flagon inlaid with brass, and the effect of which was particularly beautiful. Mr. Gurney believed it to be English, but he feared it would ultimately prove to be Flemish.

The CHAIRMAN then proposed a cordial vote of thanks to Mr. Gardner, which was carried unanimously, and the meeting adjourned.

Colonel LAMBERT writes respecting the interesting pewter cistern of Adam design which he exhibited, that he had never seen a fountain or cistern other than this one, except those he had seen hanging at the inner doors of Jewish synagogues. There should be a drip basin to catch the water when the tap is turned. Every faithful Jew moistens his ten fingers. "I will wash my hands in innocence; so will I compass thine altar, O Lord!" (Psalm xxvi. 6). Colonel Lambert adds—"It was contraband to export this mixed metal from England to the Continent, and contraband to import it. Pewter was used for the coinage of halfpennies and pennies, and a copper plug was inserted in the head (cheek) of James II. and William III., to show that the coin was intended for copper."

Notes on Books.

WOVEN FABRICS AT THE WORLD'S FAIR. By Roberts Beaumont. Emmott and Company, Limited. Manchester: 1894.

Mr. Beaumont made a special visit to Chicago, to report on the textile exhibits which were shown there last year, and this little book is the result of his journey. Taking the Textile Department as a whole, he was struck by the scarcity of British and German exhibitors, the ample display of the United States manufacturers, the excellence of French silks, and the importance of Japanese silks. In spite, however, of the want of number of British exhibitors, Mr. Beaumont found a fairly representative collection from this country. The fabrics shown by British manufacturers were, he says, second to none in excellence of manufacture and general novelty of pattern. It was in woollen manufactures that our exhibitors chiefly excelled. The United States had, as might be expected, the largest exhibit, but these did not compare with those made by English and Scotch firms; Germany ranked next to Great Britain.

With regard to cotton, although there was a very

limited number of British firms exhibiting, still Mr. Beaumont considers that in their productions was seen much of the best work in cotton and woollen yarns in the Exhibition. With regard to silk, as above-mentioned, the principal exhibits came from France and Japan; there was also a fine display from the United States. Mr. Beaumont does not appear to refer to several exhibits of crape which were shown in the British Section.

Mr. Beaumont saw much evidence of the advance which has recently been made in every species of textile work by the American craftsman, and in this progress he sees dangerous rivalry for the British manufacturers.

LOCAL GOVERNMENT ACT, 1894: a Practical Reading Reference Guide to Parish Councils and Parish Meetings. By J. Harris Stone and J. G. Pease. London: George Philip and Son. 1894. Sm. 8vo.

The authors have arranged their materials in alphabetical order, so as to form a practical handbook of information necessary for the chairman of a parish meeting, and for the chairman, clerk, and councillors of a Parish Council. The Act itself is printed in an appendix.

PRACTICAL PAPER-MAKING: a Manual for Paper-makers and Owners and Managers of Paper Mills. By George Clapperton. London: Crosby Lockwood and Son. 1894. Sm. 8vo.

The author deals first with chemical and physical characteristics of the various fibres used in paper-making, from cotton, which yields a pure cellulose, to esparto, straw, wood, &c., which require much treatment to free the paper-making material from the non-cellulose. He then describes the various processes necessary in paper-making, and devotes a special chapter to the microscopical examination of paper. In this small volume a very clear and practical account is given of the art of paper-making and of the appliances used in it. A chapter on the processes for recovering soda from waste liquors is added. A series of plates show the appearance of paper-making materials under the microscope.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JUNE 4... Royal Institution, Albemarle-street, W. 5 p.m. General Monthly Meeting, Engineers, Town-hall, Westminster, S.W., 8½ p.m. Mr. Ed. C. de Segundo, "Power Distribution by Electricity, Water, and Gas." Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. W. G. Macmillan, (a) "Experiments on the Strength of Leather;" (b) "Note on the Colour of Brass." 2. Dr. P. Dvorkovitch, "Distillation of Peat." Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Mr. Warren Upham, "Causes of the Ice Age."

TUESDAY, JUNE 5... Royal Institution, Albemarle-street, W., 3 p.m. Rev. W. H. Dallinger, "The Modern Microscope: an Instrument of Recreation and Research."

Central Chamber of Agriculture (at the House of the Society of Arts), 11 a.m.

Biblical Archaeology, 37, Great Russell-street, W.C., 8 p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Dr. E. A. Goeldi, "Critical Remarks on the Opossums of the Serra dos Orgaos, Rio de Janeiro, Brazil." 2. Mr. O. Thomas, "The New Algerian Gazelle, *Gazella loderi*." 3. Dr. C. I. Forsyth Major, "Necrolemur and its Affinities, and on retrogressive Evolution in the Lemuroids and in the Mammals generally." 4. Dr. W. Benham, "An Abnormal Vertebral Column of the Bull-frog."

WEDNESDAY, JUNE 6... Geological, Burlington-house, W., 8 p.m. 1. Sir Archibald Geikie and Mr. J. J. H. Teall "The Banded Structure of some Tertiary Gabbros in the Isle of Skye." 2. Mr. H. H. Arnold-Bemrose, "The Carboniferous Dolerites and Tuffs of Derbyshire." 3. Mr. R. D. Oldham, "The Origin of the Permian Breccias of the Midlands, and a Comparison of them with the Upper Carboniferous Glacial Deposits of India and Australia." Archaeological Association, 32, Sackville-st., W., 8 p.m.

Obstetrical, 20, Hanover-square, W., 8 p.m.

Archæological Institution, Oxford-mansion, Oxford-street, W., 4 p.m.

THURSDAY, JUNE 7... National Veterinary Association (at the House of the Society of Arts). Conference.

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 3 p.m. Sir John Lubbock, "Stipules and the Protection of Buds."

Chemical, Burlington-house, W., 8 p.m. 1. Election of Fellows. 2. Mr. Herbert Jackson, "The Nature of Phosphorescence." 3. Mr. A. E. Tutton, "The Crystallography of the Normal Sulphate of Potassium Rubidium and Cæsium." 4. Dr. James Walker, "The Boiling points of Homologous Compounds." (Part II.)

Society for the Encouragement of Fine Arts, 9, Conduit-street, W. 8 p.m. Mr. J. Starkie Gardner, "Ironwork in Europe during the Renaissance."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. W. M. Flinders Petrie, "Egyptian Decorative Art."

FRIDAY, JUNE 8... National Veterinary Association (at the House of the Society of Arts). Conference continued.

Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting, 9 p.m. Prof. C. Vernon Boys, "The Nerotonion Constant of Gravitation."

Astronomical, Burlington-house, W., 8 p.m.

Physical Science Schools, South Kensington, S.W., 5 p.m. 1. Discussion of the paper by Mr. Baly and Prof. Ramsay, on "The Relations of Pressure Volume and Temperature of Rarified Gases." 2. Captain Abney, "An Exhibition of Photographs of Flames."

SATURDAY, JUNE 9... Botanic, Inner-circle, Regent's-park, N.W., 3½ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. R. W. Lowe, "The Stage and Society."

Zoological, Regent's-park, N.W., 4 p.m. Mr. F. E. Beddard, "Sketches in Geographical Distribution." (Lecture IV.)

CORRECTION.—Page 623, col. 1, *dele* line 7 from the bottom.

Journal of the Society of Arts.

No. 2,168. VOL. XLII.

FRIDAY, JUNE 8, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CONVERSAZIONE.

The Society's *conversazione* will take place at the Imperial Institute, South Kensington (by permission of the Council of the Institute), on Friday evening, June 22, from 9 to 12 p.m.

The reception will be held from 9 to 10 p.m., in the vestibule, by Sir Richard Webster, G.C.M.G., Q.C., M.P., Chairman; Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Deputy-Chairman, and the members of the Council of the Society.

Each member is entitled to a card for himself, which will not be transferable, and a card for a lady. A limited number of tickets will be sold to members of the Society, for the use of their friends, at a charge of five shillings each, if purchased before Saturday, 16th June, after that date the price of tickets will be raised to seven shillings and sixpence. Tickets can be obtained on personal application at the Society's house, or by letter addressed to the Secretary. In all cases of application by letter, a remittance must be enclosed. Each ticket will admit one person, and must be signed by the member to whom it is issued.

Promenade concerts will be given by the Band of the Grenadier Guards in the West Gardens, by the Band of the Royal Artillery in the Indian Pavilion, and by Ashton's Blue Hungarian Band in the Vestibule, from 9 p.m.

Those travelling by railway to or from the Imperial Institute will be allowed the free use of the District Company's subway, which leads from South Kensington Station to within a few yards of the Imperial Institute road.

The cards of invitation are now in course of issue to members.

Proceedings of the Society.

INDIAN SECTION.

Thursday, May 24, 1894; Sir ALEXANDER WILSON in the chair.

The paper read was—

THE COMMERCE OF SIAM IN RELATION TO THE TRADE OF THE BRITISH EMPIRE.

By CHARLES STUART LECKIE,

Of the Borneo Company, Siam.

Being in England on a short visit from Siam, where I have resided for fifteen years, I have had pleasure in acceding to a request made me to give some information to this Society as to the commerce of Siam in relation to British trade.

During the days when Ayuthia was the capital of Siam there was a considerable foreign trade in which the Europeans took a small part. Ayuthia held its position of the capital for 500 years, and it was only at the end of the last century that Bangkok, fifty miles farther down the river, became the capital. The splendid old city of Ayuthia was besieged by the Burmans, sacked, and left in ruins, and nearly all the fine temples destroyed. One can pleasantly spend hours rambling about amongst these ruins; most of the temples are roofless with big trees growing out of the tops of the walls, and many of the ruins are strangled by jungle creepers. With Ayuthia, ninety miles from the sea by river, the system of trading adopted by the Europeans was simplified by building their trade stations, or "factories," as they were called, near the mouth of the Menam river. There were the Portugese, Dutch, and English factories, but except some tall trees near the river bank, which mark the site of the old Dutch factory, there is not a trace left of any of these.

The foreign trade of Siam during the Ayuthia days was carried on by Chinese junks and Siamese junks, and China was the great market, with Malacca and Macao occupying the position of trade emporiums now held by Singapore and Hong-Kong. Then there were the annual visits, with the fair monsoon, of the East India Company's vessels. I believe there were also trading relations between Ayuthia and Japan.

In 1826, the East India Company concluded a treaty with Siam.

About 1840-50, when Bangkok was firmly established as the trading centre, an Englishman, named Hunter, opened a business there as a merchant, and one hears the name now-a-days as being that of the man who made a very bad venture in cheap Staffordshire cups and saucers, which were quite unable to compete with the excellent pottery imported from China. Hunter's cups and saucers are prominent to-day, as he was able to sell them all for the odd purpose of adorning the famous Wat Cheang pagoda, which is one of the most handsome of the many beautiful temples of Bangkok.

Between 1850 and 1852, now 45 years ago, the late king, Phra Chom Klao, became anxious to open the country to foreign trade, and invited some British merchants of Singapore to open branch houses in Bangkok. This led to the treaties of 1855-1856 with the Western Powers. That the British Treaty was founded on British trade is clearly shown in the following wording of the treaty of 18th of April, 1855:—The respective sovereigns, it says, "desiring to establish upon firm and lasting foundations the relations of peace and friendship existing between the two countries, and to secure the best interest of their respective subjects by encouraging, facilitating, and regulating their industry and trade, have resolved to conclude a treaty of amity and commerce for this purpose."

Also, in Article 2, "It is understood that the arrival of the British Consul at Bangkok shall not take place before the ratification of this treaty, and until ten vessels owned by British subjects, sailing under British colours, and with British papers, shall have entered the port of Bangkok for purposes of trade, subsequent to the signing of this treaty."

The conclusion of the treaties was immediately followed by the establishment in Bangkok of five firms directly connected with London, Hong-Kong, and Singapore, the nationalities being two British, two German, and one American firm. As might be expected, the anticipations of Siam trade were not realised, and for many years the progress was slow. These original five firms were followed by two French firms, one of which did a most excellent business for some years in supplying the Palace with Paris goods, but it has since disappeared; of the original five firms two are still active, the place of the other two has been taken by new firms of British or German

nationality. Steam rice mills and go-downs soon began to appear in the European quarter, and were the sign of European trading enterprise in the same way that the "factories" of two hundred years ago marked the foreign enterprise of that time.

I have thus sketched roughly the history of the opening of European trade with Siam, and I now turn to the geographical position of Siam as affecting the trading conditions of the country.

Starting from Singapore you have a four days' voyage, practically due north, to the top of the Gulf of Siam, where three rivers flow into the sea. The Menam (the Bangkok river), with its tributary the Tachin, the Eastern River (the Bangpakong), and the river from the Burma Hills to the north-west (the Meklong). About thirty miles up the River Menam lies the capital of Siam, Bangkok, practically the one and only trading port of the country. The fact of a large country like Siam having one port only for foreign trade gives the foreigners connected with trade the one advantage of seeing the entire trade of the country pass under their immediate notice. Taking then Bangkok as the trading centre, we will consider the position of Siam as viewed from Bangkok. In Bangkok we are placed in a very rich alluvial tropical plain, watered by the three rivers I have named, and producing the great crops of rice which form the chief wealth of Siam. This plain of the Menam extends from the sea about 120 miles north, as the crow flies, and has an average width of about 50 miles east and west. This large stretch of country is exceedingly well watered, well populated, and very rich, and turns out some 500,000 tons of rice, in good seasons, available for export. Then there is the long coast line of Siam, extending down the Gulf of Siam from Bangkok to Pahang, on the east coast of the Malay Peninsula; also a similar coast line on the Indian Ocean from Tenasserim to Perak on the western coast of the Malay Peninsula. At the present, the trade is very small from both these coasts, although the excellent situation of the latter coast on the Indian Ocean gives hope of a trading future, more especially as the hill country is rich in minerals. The third coast line is the east shore of the gulf, stretching from Bangkok down to French Cambodia; 150 miles from Bangkok, down this coast, is Chantaboon, a place at present occupied by the French. The Chantaboon district is of importance to Siam trade as the centre of the pepper trade, sending

1,500 tons or more of pepper to Bangkok each year. Behind Chantaboon lie the two very wealthy Siamese provinces of Battambang and Siemrap, and Chantaboon is the key to these exceptionally rich districts, which extend right away to the lower Mekong to the north-west of French Cambodia. Such provinces as Battambang and Siemrap may well cause envy to the neighbours of Siam, for they are the centre districts of that ancient wealthy empire marked to-day by the grand ruins of Angkor and other places. These ruins are reached from Bangkok by following the eastern river, Bangpokong, or by going from Chantaboon to Battambang, an easy journey of a few days only.

At the north of the Menam rice plain, where the rivers Me Ping and Me Poh join and form the Menam (the Siamese name is Menam Chow Phya), there is a long stretch of low-lying jungle country, extending up the Me Ping to Rahang, and then comes the first mountain range, to the north of which is the fine plain of Cheangmai, 1,200 feet above sea level. The chief tributary of the Me Ping is the Me Wang or the Lakon river. The Me Poh, coming from the east, has a large neighbouring stream, the Me Yome joining it a few miles above Paknampho; these rivers flow from the north and north-east, and pass through the towns of Nan and Phræ, places selected by the French Government as suitable posts to establish French consulates in Northern Siam. If you look at a map you will see that Nan and Phræ are not far from Luang Prabang, the important point in the territory recently taken away by France from Siam. From a trade point of view these valleys of the Me Ping, Me Wang, Me Yome, and Me Poh are a valuable second geographical feature in the commerce of Siam, as it is in these watersheds that all the teak forests lie; they are important too to British trade in Manchester and Bombay cotton goods, as the population is considerable.

Over the hills to the east of the Menam basin there is the big Mekong plain. This stretch of country has hitherto meant little to the foreign trade of Siam owing to difficulties of communication. Except such products as gamboge, gum benjamin, silk, ivory in small quantities, Bangkok receives no produce from the Me Kong, and the market on that side for Manchester goods is very small in comparison to the large stretch of country. Perhaps the most easy way to grasp the size of the Mekong plain on the west of the Mekong river, the splendid plain, which after all the troubles of

last year still belongs to Siam, is to give you the measurements; it is roughly 250 miles from west to east, and 200 miles from north to south. I have often heard of the rich rice lands of this plain, and the other products, I have been told of, on good authority, are copper, lead, iron ore, tobacco, silk, cotton. The population, all along the big river and along the rivers which flow into it, is considerable.

The rich valley of the Bangpakong river joins the lower end of the Menam plain, and besides the productive rice district of Patriew one meets farther up the river with the gold-bearing country of Kabin, due east of which is the new gold district of Wattana.

Thus the importance of Siam to the British trader lies, first, in the large surplus production of rice from the rich alluvial plains of lower Siam, which with the introduction of fresh enterprise will be increased by irrigation works and facilities of carriage; secondly, in the teak forests of Northern Siam, and, thirdly, in the pepper cultivation of Chantaboon, while the products of the eastern provinces of Battambang and Siemrap and the great plain of the Mekong await development, by the extension of the system of railways which the Siamese Government have planned.

I will now explain to you the share the British take in handling this produce.

When I first went to Bangkok, in 1879, there were five European rice mills and five Chinese or Siamese mills on the Bangkok river, and one Siamese mill on the Eastern river. After 15 years, these figures are much altered; there are still five European rice mills, but the Chinese and Siamese mills have increased in number from five to 21 in Bangkok, besides three mills on the Eastern river. The Europeans have only just managed to keep the control of the same number of mills they worked 15 years ago, while the Chinese or Siamese have increased their holdings four-fold.

The Europeans have taught the Chinese to mill rice by steam, and, with the Chinaman's trading ability, backed by the wealth of the Siamese, John Chinaman has gained the hold on the rice trade of Siam, which the Europeans of 40 years ago looked to secure to themselves. The European in the East generally gives himself the credit of leading, and the Chinaman is supposed to follow. In Bangkok we have an instance of the white rice industry being pioneered by a Singapore Chinaman, a British subject, supported by his Scotch engineers, and, after some years, the Euro-

pean millers in Bangkok followed his lead. Of late years, the Bangkok and Patriew rice mills have been a favourite investment of Siamese princes and nobles, who now own many of the mills, or hold mortgages on them. The wealthy Siamese princes have always been fond of trade, and, after the treaties were made, they gave their support very freely to the Bangkok Chinese, who carried on a large trade with Siamese capital.

The chief export of rice is to Hong-Kong, closely followed by Singapore. Hong-Kong distributes this rice for the most part to Canton. Singapore distributes to Java, the native States of the Malay peninsula, and to Europe. During the last few months, Singapore sent Siam rice to the Madras coast and to Suakim.

In a year, when we have a full crop to handle, Siam exports rice direct to Bremen, Hamburg, Liverpool, and there is now a growing trade to South America. It is interesting to see how very largely the rice trade of Siam is connected with British trade. The native industry of growing paddy is almost entirely in Siamese hands, as is natural, and merchants do not yet advance against growing crops; it is as well to add it is seriously to be hoped for their own sakes they will never try such advances. But after the natives have brought the rice to the mills, we find all the machinery is Scotch or English; that the bags for packing the rice are made in Calcutta in the great jute mills there, which in themselves are one of the many strong marks of British enterprise in India; that the steamers which take the rice away are for the most part British, and the last, but not least, the financing for the shipments is carried on by British banks. The direct export of rice from Siam to such countries as Germany, Java, Manilla, South America, is financed almost entirely through British bankers or merchants, and the smaller item of insurance, both fire insurance on the mills and godowns, and marine insurance on the shipments, is chiefly done by British insurance companies.

When we look into the moving forward of the rice, after it is prepared in these mills, we see the British again have a very large control.

Shortly after the treaties the Siamese built a fine fleet of sailing ships—at one time there must have been 50 vessels belonging to Bangkok—which were excellent craft, all built of teak wood, and designed and constructed by English and Scotch builders in Bangkok. As recently as 1870, there were

quite a number of these ships trading regularly between Bangkok and Hong-Kong, Singapore, and Java; they have gradually disappeared, and in Bangkok, to-day, there are only two of these ships left, for typhoons in the China seas, and sales to foreign flags, or for "breaking-up" purposes in Canton have cleared them all away.

The chief competitors of the Siamese sailing fleet at that time were the North German vessels, from Flensburg and the neighbourhood, for there were many of them on the Chinese coast. The Siamese flag has gone, and the British flag has replaced it, and to-day the carrying trade of Siam is for the most part a British trade.

The last statistics shown in the Consular Report for 1892, a year of great scarcity of rice and teak, are vessels cleared:—

	Tons.
British	174,500
German	14,600
French	2,300
Siamese	1,300
For six other nationalities	8,400

Giving a total for the year. . 201,100

The French flag (2,300 tons) is the monthly voyages of the Saigon subsidised steamers. You will notice the British share is over 86 per cent.

Through the enterprise of Mr. Holt, of Liverpool, and his friends, and of the Scottish Oriental Steamship Company of Glasgow, we have two excellent lines of British steamers, the former running between Bangkok and Singapore, and the Glasgow Company holding the Hong-Kong trade pretty much in their own hands. Besides these two good services, we have regular visits of the British steamers belonging to an English firm in Swatow, and a small British-owned steamer trading regularly between Bangkok and Bombay, also two British Chinese-owned Singapore steamers.

A long way behind us comes the German flag, which is represented by steamers taken up by merchants for a few trips or for a few months, and the North German Lloyd Company run a small steamer occasionally between Bangkok and Singapore. A good proportion of the direct rice cargoes from Bangkok to Europe are carried in German vessels. The French flag was represented for a few years by an odd little steamer with a French name and a large French flag, which ran between Bangkok and Saigon under a substantial French Government subsidy. This boat was

chiefly noticeable as making lengthy stays in Bangkok doing nothing, as there was really nothing to do, and last summer this queer little boat came to grief with a shell through her hull while piloting the French gunboats into the mouth of the Menam. One can count on one's fingers the French trading vessels which have visited Bangkok during the past ten years. With regard to the outside steamers and sailing vessels which come to Bangkok for full cargoes of rice for Germany, England, or South America, and for teak cargoes for Europe, it is in but very few cases that the freight and cargo have not been arranged and financed for in London.

In connection with the shipping, there is one feature of Bangkok trade worth mentioning. We have on the Bangkok river a fine fleet of sailing lighters. There are over fifty lighters with a carrying capacity of 200 to 250 tons of rice, excellent sea boats with Chinese crew and Chinese rig, and built of teak throughout; these lorchas are owned by the merchants, and employed to send their rice and teak outside the Bar to the Kolsichang and Anghin anchorages, 60 miles from Bangkok, where the vessels go to fill up after crossing the Bar. A score and more of the Bangkok lorchas are owned by British subjects. The Scottish Oriental Company also employ, for their own steamers, a Clyde built steam lighter under the British flag. The Bar at the mouth of the Menam is responsible for the fleet of lorchas; it gives us all a good deal of trouble, and engineers tell one a channel could quite easily be cut through it and kept clear. The Siamese Government, however, prefer to preserve it as nature made it, with a maximum draft of water of thirteen to fourteen feet at high tide. When once inside the river there is enough water at all times of the year for ocean-going vessels of the deepest draft. The question of cutting a channel has been repeatedly brought before the notice of the Government, but, hitherto, all propositions are met with the old answer, "Better leave it as it is."

When we come to the next important industry of Siam, the teak trade, we have a trade almost entirely British. In the northern towns of Chiangmai and Lakon, one meets with British houses established in business, directing the working of the teak forests; one meets with British Burmans and Shans in numbers working the forest contracts; and when the teak has been passed down to Bangkok, you find three steam mills belonging to

British firms, and one only worked by a Chinese-Siamese firm. There are four smaller establishments with some machinery: one, an Anglo-French firm; another, Austrian-French; a Dutch, and an Italian; but those four firms together do but a very small export business. In these mills you again find only British machinery. As the export of teak from Siam is almost entirely confined to Europe (the cargoes being sold through London), or Bombay, or Hong-Kong, one may speak of the teak trade of Siam as a British trade, carried on by British capital and British management. London merchants have put down large sums of money in the north of Siam in this teak industry, for the business entails the employment of a large capital. There are no German or French firms connected with the northern teak forest works.

Ten years ago the British trade in teak was confined to the Bangkok district, and the only means open to the Bangkok merchants of securing teak was by buying rafts of rough timber, from the natives, as they reached Bangkok, or by buying hand-sawn squared teak from the Chinese hand-sawyers in Bangkok. Nowadays, the British firms work the wood themselves out of the forests, and pass it down the rivers to their Bangkok mills.

A teak forest is generally supposed to be something entirely different from what it actually is. One can go up the bed of a stream flowing into one of the northern rivers, and you may walk miles without seeing a single teak tree; you meet with paddy-fields, dense jungle, open jungle, mountain gorges, splendid scenery: but the thing you meet with seldom enough, when looking keenly for it, is a teak tree. The teak grows here and there, on the sides of the hills which spread for miles from the stream; and although in places it grows in rich patches, it was never my fortune to get into a really rich patch. The method of the work is tedious. A forester sends his elephants, in care of their mahouts, into the forest, for which his employers have a lease from the Government, or the working rights from the holder of the lease, and drags, during the rainy season, as many logs as his elephants can manage to the bank of the stream. It is quite a usual thing for the teak to be dragged four or five miles to the stream, and it is a good forest which can show a record of 50 logs being worked by one elephant in one season. The elephants then stack the wood on the bank of the creek, where it awaits the inspection of the buyer. After measuring, the logs are put into the stream,

and then comes the great delay, often enough, of waiting for sufficient rain to float the wood down the streams into the rivers. With a moderate rise of water, the elephants follow the wood along down the river bed, and push it off sand banks and rocks where it sticks, and get it into the river at last. When once in the river, the wood is left to itself, if the water is too deep to allow the elephants to walk down the river bed, and the logs spin away down stream unassisted. After passing through the rapids, which descend to the low lands extending from the sea to the foot of the northern plateaus, the wood is caught by rafters, and tied up into rafts of 150 on the Me Ping, or 100 logs in the Eastern river, and sent on down the 400 miles or so to Bangkok in care of the Siamese rafters. The rafting waters are from June to November. The work is slow, for the average time used in delivering a teak free into Bangkok, from its stump where it was felled, is about three years, although the distance actually covered is not over 600 miles.

The Burmese and Shan foresters who work for the British firms are all British subjects, and as the trade is carried on for the most part through them, the teak trade in the forests is really a British trade. The owners of the forest leases, with but few exceptions, are the Laos chiefs and princes, who receive a royalty on every log worked out of a forest, and the Government collect a second duty before the wood enters Bangkok. The labour is mostly supplied by the native hill tribes, Kamouks and Kariengs. Kamouks come to the teak workings from across the Mekong, and as they are now being cared for by the paternal Government of France, it is possible our labour question in the teak forests may become difficult.

The preservation of teak forests, which has had such excellent attention from the British Government in India, has been ignored in Siam; but we now begin to hear of certain stipulations being put into new leases, imposing on the lessee the obligation to plant four teak saplings for every one tree felled during the term of a lease. The British firms buy only wood which has reached a certain maturity, and their contractors deliver no very young wood. But the natives send down to Bangkok annually large quantities of quite young teak; this has gone on unchecked by the Government, and several thousands of these logs come on the Bangkok market every season, and are bought for posts and light beams and house work. The

simple remedy of forbidding the delivery past the Government Timber Duty Station of all teak below a certain girth would cure the evil quickly, and prevent any necessity of irksome stipulations being imposed on British traders.

The annual export of teak from Siam to Europe, Bombay, and Hong-Kong is likely to increase, as the northern forest work gets better organised, and the elephant force employed increases. The annual supply of rough logs into Bangkok is so entirely dependent on the rainfall for the year that there must always be the great variation in quantity shown by the export lists of the past six or eight years. I will mention here that the coinage used in the north of Siam is the Indian rupee. As soon as the Cheangmai plateau or the Lakon, Phrae, Nan, or Ootaradit districts, and the rich Mekong plain are reached, the Siamese Tical ceases to pass current; and in this large section of Siam the British rupee is the only coin the people understand. The British teak firms have to import their rupees and send them up to Cheangmai. It is interesting to find a large portion of Siam using British coin, and maintaining it for many years after the establishment of the Tical Mint in Bangkok.

After rice and teak I will take the export of pepper as the next important product in the British trade of Siam. The chief market is London, and Hong-Kong takes all the rest. Three British firms and one German firm export nearly all the pepper from Siam to Europe. If the French remain in Chantaboon they will quite certainly try and divert the pepper trade to Saigon in place of Bangkok; even if they failed to succeed, which is probable enough, they would make it more difficult for the Bangkok traders.

Other exports from Siam of importance are cattle, hides, and horns, sapan-wood, rose-wood, ebony, cardamums, gamboge, gum benjamin, teelseed, and raw cotton; also fruit, fish, and eggs in large quantities to Singapore. Under favourable conditions of rain the export of teelseed and of raw cotton makes a small business, chiefly in Chinese hands. The sugar export of Siam has gradually died out, and against a regular annual export up to 15 years ago of the surplus production, there is now no export and a steady growing import.

The export of cattle from Bangkok is entirely to Singapore, and Mr. Holt's steamers are specially arranged for carrying cattle on deck.

The trade is in the hands of British subjects, and nearly all the people employed in it in the Bangkok district are British Indians from the Madras coast. There is also a northern export of cattle from Siam to Burma. For the buffalo hides and horns the market is London. The market for sticklac, gamboge, and gum benjamin is also London, shipment being direct, or passing through the hands of Singapore produce dealers. Raw cotton goes to Hong-Kong, for China or Japan; teelseed goes to Marseilles.

An important trade lies in the export of dried and salt fish to Singapore and Java. At the top of the gulf, near the mouth of the three rivers, there are large fisheries of the Siamese herring—the Platu—and in the winter months there is a big export to Java of salted platu. In dried fish there is also a large business, and numbers of Siamese earn their living as fishermen. Both the salt and dried fish export is entirely in the hands of Chinese, and at times it is a highly profitable trade. Some few years ago a Siamese prince brought out to Bangkok a North Sea steam trawler, fitted up with refrigerating rooms, the idea being to bring fresh fish up to Bangkok, but the scheme didn't work at all, and the fisheries have relapsed to the old-fashioned means of fishing stakes on the shallow bar waters.

Other smaller products are not of sufficient importance to take up your time by making reference to them.

The great customer of Siam is the British Empire. What Hong-Kong and Singapore may not themselves handle in transit, passes through London hands for the most part, and the per-centage of the entire produce of Siam which is not brought by the merchants of Hong-Kong, Singapore, and London is the smallest fraction. Excepting the direct shipments of rice from Bangkok to Bremen, I do not believe that 1 per cent. of the entire export of Siam is placed without the merchants of these three ports assisting the produce to its final destination.

If I refer to banking a moment, you will be glad to know that in Siam the only banks are British banks. The senior bank opened in Bangkok in 1888, and is now a well-established prosperous branch of its head office, enjoying the confidence of the Siamese Government and of the merchants. Those of us who worked for years without any bank appreciate the advantages we now possess, and the blessing of a note issue in place of ponderous bags of silver. The second bank has just commenced work and

has every chance of becoming as popular as the pioneer bank.

The British share in the import trade of Siam is very large. Nearly the whole of the cotton goods—plain and printed—and yarns, are imported from Lancashire or Bombay; such flannel as is used comes from Germany; and Switzerland sends a share of the prints, while the richer Chinese inhabitants bring silks and other specialities from China. Lancashire and Bombay practically supply the clothing of the whole people. There is a considerable import of other British manufactures, such as machinery and hardware, and of late years an increasing import of sugar has been made from the English-owned factories of Hong-Kong.

A trade which has shown a large increase is the import of kerosene oil. A German firm have erected large tanks for storing kerosene in bulk, carried to Siam by a new line of tank steamers belonging to an English company in London. The old cocoanut oil lamp, or an abominably smoky torch, or a crude beeswax candle, which the Siamese had used for centuries, are now being superseded by Russian, American, or Sumatra oil burnt in German lamps. The British seem unable to compete with the cheap lamps and cutlery supplied by Germany, or with the excellent crockery brought from China, where the potters follow the exact requirements in shape and colour of the Siamese. The large bales of gunny bags for packing rice, which are an important item in the upward freights from Singapore, I referred to when speaking of the rice industry. The rice mills in Siam use about 20,000 bags per day.

The coal trade of Bangkok is a small one, as the fuel used in the rice and sawmills is the otherwise useless husk from the paddy, and sawdust from the floors of the teak mills. There is plenty of firewood brought into Bangkok for use of steam launches and cooking purposes.

With the excellent coaling stations of Hong-Kong and Singapore close to us, it is impossible to expect that a coal business of any moment can ever be built up in Bangkok.

Galvanised iron, which steadily increases in use, comes from Belgium.

Germany has had a fair market for beer in Bangkok, which the English brewers of light beer now propose to share.

Cheap bad brandy comes from France and Germany, and, unfortunately, finds a ready sale. This brandy, cheap scents, Paris trinkets, quack medicines, and a little wine, compose the French trade into Siam.

The total import of opium into Siam averages 1,000 cases yearly, and is all the Benares drug. If France sends the cheap brandy, we send the opium.

I have briefly enumerated the chief articles of European and Indian production brought into Siam, but in addition to this Hong-Kong sends down to Bangkok large quantities of all sorts of Chinese goods for native use, and the trade in matches has been taken possession of by Japan.

I have run through the exports and imports of Siam and will now mention the railways and mining enterprises, both of which are now having the attention of the Government.

The most popular local company in Bangkok is the tramway company, and much credit lies with the Danes, resident in Bangkok, for the excellent footing on which they have placed this company. The concession was given by the king to a prominent Dane and to a Britisher. The shares were taken up by the Danes, British, and Siamese, and a few subscribers of other nationalities. Taking advantage of the example of errors made by the Singapore Tramway Company, the Bangkok Company commenced operations with light pony tram-cars, and made such good progress that they were soon able to extend their line over the full length of the six miles of the concession. The management has been in Danish hands from the commencement. When the success of the concern was proved, the directors replaced the pony cars by heavier electric cars. An American firm got the orders for this installation, and the work seems to have been well done, judging from the regular working for the first year. The directors are well satisfied that they have obtained greater efficiency and greater economy by introducing electric power. Cheap fuel for driving the dynamo is obtained from the saw-dust from the neighbouring teak mills. The share register of the Bangkok Tramways Company, as shown in the Consular Report for 1892, gives 1,174 shares held by Danes, 1,004 British, 736 Siamese, and 586 shares held by shareholders of six different nationalities.

The second railroad enterprise was the Paknam Railway Company. This is also due to the determination of a Danish resident, and like the tramway company is a similar Danish-Siamese-British concern. The development of the scheme, and the construction and management of the company have been in Danish hands from the commencement. The railroad to Paknam and the tramway were laid

by a Danish engineer, a partner in an Austrian firm under French protection. Such a mixture of nationality as this is one of the odd points in Bangkok. The largest shipping firm, for instance, which handles the bulk of the British steamers is a French firm without a Frenchman ever being in it; the business is essentially British, the earnings are derived from the British flag, the partners have been Germans for the most part, and the office is essentially German. The protection of France has been popular amongst Europeans and Chinese in Bangkok for many years past, as the officials of France are considered always prompt in supporting the claims and advancing the interest of French subjects.

The train service of the Paknam Railway has been working for a year now, and the results are not disappointing. The line runs from Bangkok to Paknam near the mouth of the Menam, a distance of fifteen miles.

The Korat Railway is the third railroad undertaking now in course of construction. The contractors are Scotchmen, the Government department is in the hands of the Germans, and the result has been delays and vexations and a number of disputes which have ended in arbitration. The Korat line of 150 miles will scarcely be finished before three or four years, and it is believed the Government then intend to extend it right across the Mekong plain to the river, either north to the big elbow or due east to the Lower Mekong. The Mekong basin which forms so large a part of the colour of Siam on any map, is undoubtedly a very fine country, and fairly populated near the river, and along the valley of the large tributaries flowing into it. Until the Korat Railway is completed it scarcely comes under the head of the "Commerce of Siam" as the country is so much shut off from our Bangkok district, and trade communication is only kept up by packmen and pedlars, who travel across the hills with their bullock caravans, carrying light products and small quantities of European goods. The railway is being made through Ayuthia and then strikes across the plain in an easterly direction and over the hill range, at the top of which is the high plateau of Korat at the west of the Mekong plain. The fine country to the east of the Mekong was forcibly taken from Siam by France last year. The French have acquired a number of square miles, a slice of country in fact which looks well on any map; by the way, it seems as if this acquisition had merely whetted the French appetite instead of

satisfying it. When the Korat Railway is completed, with its extensions to the north and east, we shall have a clear instance of "tapping new markets," as the railway men call it, and until the result is shown by proof, we can all wait in pleasant anticipation of the excellent results to be derived from "tapping" which everyone hopes for. In the meantime the Siamese Government most certainly deserve the best support of all British traders in any endeavours they make to open up the Western Mekong country which is still left to them by the French Republic.

There are various other railway schemes being talked of in Bangkok, and the Siamese are inclined to encourage the making of railways to facilitate communication with some of the richer provinces of their country.

With all the keenness of the British traders for business, I would like to draw your attention to the British share in the railway and tramway work. They have supplied the rails and the rolling stock for the two railways, and the rails for the tramway. They are building the Korat line. This is the British share as yet. The Danes control the tramway company and the Paknam Railway. The Germans are the chosen executive officers in the Royal Railway Department of the Siamese Government. The Austrian firm, under French protection, with a Danish engineer, build the tramway and Paknam Railway. The American firm supply the electric driving power. The Britisher has all his work before him to hold his own in an open field like Siam, with most able competitors against him of many different nationalities.

I will not do more than refer to the projected railway from Maulmein, through Northern Siam, to the frontiers of China. The expected advantages to be gained by the construction of this line have been fully explained in the addresses and writings of Mr. Holt Hallett.

Other companies in Bangkok are the Electric Light Company, with a splendid lot of machinery costing £50,000. The lighting has been delayed for a few years by financial difficulties, and matters are at a standstill. The Bangkok Dock Company is a most useful local company, with a good machine shop controlled by Scotchmen; mills and steamers and steam launches give the dock company plenty of work.

A very excellent and remunerative undertaking has been organised by a German resident, the running of small river ferry boat

steam launches all over the Bangkok, Ayuthia, and intervening districts. The service is well managed, the boats are fast and keep good time, and are quickly taking the place of the small canoes and native boats.

Mines.—The mines and mining schemes established in Siam to-day are as follows:—"Goldfields of Siam," with Bangtaphan on the north-east coast of the peninsula, as the centre. The shares of this company are quoted on the London Stock Exchange, and the present value of the shares indicates correctly the condition of the work. The Kabin mines are now being opened by an Englishman, and preliminary work is going on. The Wattana Mine is a concession to a Frenchman, and work is also being started. Both the Kabin and Wattana mines are well up the Eastern river (the Bangpakong), and lie at the foot of the Mekong plain towards Cambodia.

There is a Sapphire and Ruby Company of Siam in London, with valuable concessions in the district behind Chantaboon. Work has gone on in that neighbourhood on a large scale for the past fifteen years, and the trade has always been in British hands—long before the London company got their concession. The miners are nearly all Burmans, some of whom live in the district, and others come and go each year, and work in the least unhealthy season.

Reports of deposits of various minerals, gold, silver, antimony, lead, tin, plumbago, are continually being received by residents, and the Siamese Government having formed, under two English experts, a Government geological and mining department, one can well hope for an early development of the mineral resources of Siam.

Population.—In considering the population of Siam we must bear in mind there has never been a census taken. Ten years ago, one heard in Bangkok the population of the city and suburbs put at 350,000 to 500,000 people. Nowadays, in spite of a large, steady growth during the decade, the general idea amongst Europeans lies nearer to a figure of 250,000. This is only guesswork. The population of Siam is spoken of as 8,000,000 or perhaps, even 30,000,000, which leaves every one a good margin of choice. After noticing the population of other places more closely than I formerly did, I should give an estimate of 150,000 to 200,000 for Bangkok, including the boat population, and the total for the whole of Siam of 6,000,000 to 8,000,000.

In Bangkok one meets with communities of

the following distinct types:—Siamese, Chinese, Malays, Tamils, Peguans, Laos, Annamites, Burmans, Shans, Bombay Mahomedans, Arabs, Javanese, and a few Japanese, Cingalese, Pathans, Parsees, and Bengalis.

Of the Europeans there are, roughly, 200 British, 100 Germans, 50 Danes, and 20 or so each of Americans, Italians, French, and a few Austrians, Norwegians, Swedes, Dutch, Belgians.

The division of labour in Bangkok is interesting. The Chinese do all the heavy coolie work and cargo boat work. The Siamese do the boating work, rafting, and light manual work. The tradesmen, carpenters, sawyers, tinsmiths, and blacksmiths are Chinese; the Malays work the machinery in the steam mills, and take a share in paddy cultivation and cattle-dealing, and do a good deal of fishing; the Javanese are the gardeners. The market gardening is a large Chinese industry. The Annamites are fishermen and boat builders; the Bombay men are merchants; the Tamils are cattle men and shopkeepers; the Burmese are the sapphire and ruby dealers and country pedlars; the Singalese are the goldsmiths and jewellers; and the Bengalis are the tailors. Over a course of years, the most marked progress lies with the Chinese or Chinese-Siamese, who gradually and surely strengthen their hold in Bangkok. They marry Siamese wives, and more often Siamese-Chinese wives and their children wear the pigtail. They make an excellent people, and seem to have many of the better qualities of both father and mother.

Climate.—I am afraid there is not very much to be said in favour of the climate of Siam. A man who lives there for many years and keeps his energy, must have had a very good stock of superfluous force to start with. Doctors living in Singapore and Hong-Kong give Bangkok a bad name, but they naturally enough judge from the shattered people who have left Bangkok in search of health, and pass through their hands on the way to Java hills or to Japan. When one has said that the climate is enervating, the worst fault has been named. Men of sound physique, after many years' residence, lose power, even if they have uninterrupted good health. The heat is trying enough, but it is not anything like as severe as in many of the Indian ports and stations. In our dry hot season, from early March to middle of May, we have a mid-day temperature of 93°, followed by 97° for a few hours in the afternoon, an evening temperature of 88°,

midnight 80°, early morning 85°. June and July are generally very pleasant months, with a breeze and frequent showers. August, September, and October are hot again, and damp and exhausting. In November the rains stop and a cool wind sets in. December, January, and February are dry, cool months, very similar to southern Spain in March and April. In these winter months we frequently have a morning temperature of 65°, mid-day 80°, evening 75°. In fifteen years in Siam I have never seen a properly placed thermometer register below 50° or over 100° in the shade—although in the hill districts greater extremes are met with.

In Bangkok we are very badly in want of a good supply of drinking water, and bad water is a most serious drawback. The Menam is the High-street of Bangkok, the main drain, the dustbin, and the drinking water supply for the large population. The natural consequence is that occasionally there is much sickness, which might be avoided if the Government would give the town a good supply of clean drinking water from the hills at the back of Ayuthia, 60 to 70 miles away. Schemes and plans have been frequently discussed, but nothing is done.

Rainfall.—The only two reliable records which I know of, were the figures collected by the surgeon of the British Consulate in the sixties, when the average was 57 inches per annum. I kept a careful Bangkok register for ten years, from 1882 to 1892, and the average was only 51 inches. The extremes were 75 inches maximum and 33 inches in any one year. The Siamese Government are now giving attention to watching the rainfall, and have instructed the outlying provinces to send in their annual returns. In a purely agricultural and timber country like Siam, with the shallow rivers of the country the only means of transport, the rainfall is the chief factor in deciding whether good or bad trade is to be the condition of things in Siam for the next following year.

In any review of the trade of Siam, it is essential to refer to the political questions of the day, which have such a direct bearing on the continuance of trade on a stable basis. Since the events of last summer, when the French became actively aggressive, the difficulties of Siam, as an independent Asiatic kingdom, have been very evident. The unfortunate troubles that came to Siam had long been brewing. There were many points in dispute, and the French authorities in Bang-

kok had repeatedly asked for settlement of certain claims of private individuals. The Siamese considered these claims preposterous, and declined to pay. The chief difficulty lay in the demand of the French that the Siamese should withdraw themselves from the country, east of the Mekong, which was claimed by the French as belonging to Annam. The Siamese naturally enough maintained their right to keep their own country east of the Mekong. We then heard of the Mekong expedition from Saigon, to remove the Siamese from the territory claimed by France. Besides the Saigon force, there were two small French expeditions sent inland to the west over the hills, starting from the Annam coast to co-operate with the main force from Saigon. Matters went very slowly on the Mekong, and then, finding progress difficult, the French sent gunboats to Bangkok, which, contrary to the orders of the Government in Paris, forced their way past the Paknam forts. The French demands were then handed in to the Palace at Bangkok, backed by three gunboats representing the armed forces of the great French republic. Some hitch occurred over the settlement. The French Minister hauled his flag down, and went outside the Bangkok river with the French gunboats, and took up temporary quarters at Kohsichang, where the French flag was hoisted on the island. Kohsichang is the anchorage and outer port of Bangkok for the south-west monsoon months, from February to October. The next move of the French was to send up more men-of-war and gunboats to Kohsichang, and to declare a rigid blockade. This was a simple and inexpensive course for the French to adopt, as they had no trading vessels to consider, and they were fully aware that the loss caused by the blockade would fall on British shipping, and on British and German trade.

The British man-of-war *Pallas* and the gunboat *Swift* were moved outside the blockade limits. The British gunboat *Zinnel* was in Bangkok at the time the blockade was declared, and remained up in town opposite the British Legation. Although the blockade only lasted a few days it dislocated trade for several weeks.

Matters took a more favourable turn, and the blockade was raised. The French Minister after some further delay, returned to Bangkok, and hauled his flag up again. The Siamese then submitted to French demands, which were, briefly an indemnity in cash of 3,000,000 francs, the annexation to France of the entire

Siamese east bank of the Mekong, the right to establish consulates in certain districts on the Menam watershed, to withdraw all troops from a range of 25 kilometres west of the Mekong, and from the neighbourhood of the big Cambodian lake in the Siemrap and Battambang country, and to bring to trial certain alleged offenders complained of by the French during the hostilities. There was one most objectionable clause in this treaty forced on the Siamese, namely, the "pacification" of the east bank of the Mekong. While the Siamese had to withdraw all their troops, even to 25 kilometres west of the Mekong river, they were held responsible for the peaceful submission of their former subjects on the east of the Mekong, over whom they had, of necessity, ceased to have any control whatever. Chantaboon was to be occupied by the French until all these conditions had been fulfilled.

The Siamese set to work at once, and undoubtedly did their utmost to carry out these terms—the cash was paid immediately, the country east of the Mekong was handed over to the French, and the trial of the alleged offender commenced—this trial of Phra Yot, a Siamese official, was held in March in Bangkok, and after a very complete inquiry the accused was fully acquitted—but the French are not satisfied, and the case is to be tried again before French and Siamese judges.

In the meantime the French hold Chantaboon.

The British traders in Siam and those who trade from outside with Siam, find themselves in all this cramped and harrassed by the uncertainty as to the possible course of events. A large British trade with Siam has been built up by British traders; the French with the same facilities have built up no trade. The French have disagreements with the Siamese and settle them in a forcible manner which must necessarily entail an entire disregard of any British interests in Siam. This was most clearly proved to be the case last summer.

The British trader growls and feels his foolish position, for whenever the French see fit they can blockade Bangkok and cause an immediate direct loss to London, Singapore, and Hong - Kong merchants, and to the British shipowners who practically hold the carrying trade of Siam in their own hands. A blockade of this kind is excellent fun for the Saigon party; it means a pleasant outing for the French gunboats with no risk; it means British trade with Siam stopped dead by a

stroke of the pen of a French admiral ; and at the end of it all the Siamese are made to pay the picnic bill of their own blockade.

When a British trader growls to a British official, an answer he sometimes receives is to the effect that his troubles are entirely his own fault, and that as long as he continues going to countries where no one wants him, he will certainly meet with grave disadvantages.

Every British trader in Bangkok, and British traders connected with Siam at home or in India, Hong-Kong, or Singapore, have established their trade relations with the country under the security of the treaty their Governments made with Siam. They have, therefore, a right to require that Great Britain will maintain her part in the treaty with due consideration to the interests she has herself fostered.

Most of you know that the policy of France, in her Indo-China Empire, is the very opposite of our own. Frenchmen think that their colonies are for themselves for their own individual benefit, and for the advantage of their own home trade. The immediate result of this narrow view is the imposition of high protective tariffs and differential duties, placing every possible obstacle in the way of the trade of their European neighbours, and of the trade of the British Empire. With the broad minded and open-handed example of Hong-Kong and Singapore close to their doors, they never follow our good old British lead of open ports and equal rights to foreigners of any and every nationality ; in fact, they keep increasing in Saigon their hostile tariffs.

In conclusion, I will ask you all to bear one thing in mind, that, if any further calamity happens to Siam, and Bangkok became a second Saigon, we know clearly beforehand the handicap which would be placed on British trade, a handicap sufficiently heavy to entail the eventual retirement of British traders from the internal commerce of Siam.

DISCUSSION.

LORD LAMINGTON said they were much indebted to Mr. Leckie for having given such a very useful paper. He had from time to time read many reports about the commerce and internal economy of that country, but never came across in so concise a form so valuable a contribution to our knowledge of it. Mr. Leckie had had a very large experience in Siam. He had shown that in 1840 there was only one British merchant, whilst now our interests in Siam

were very considerable. He had also shown what a fatal blow it would be to the commercial interests of the country, not only to Great Britain, but also to Hong-Kong and Singapore, should any interference take place with the commerce of Indo-China. The rice trade, in particular, was practically a matter of British concern, both directly and on account of the various adjuncts necessary to it, and the teak trade was in a similar position. The imports into the country were also mainly of British origin, or from our Indian Empire. Where both imports and exports were British, and a great part of the people were British subjects, viz., Indians, Burmans, Shans, Malays, and Chinese, all looking to British protection, and where the coinage in a great part of the country was the rupee, whilst tramways and railways were being constructed by British contractors, it was very evident how greatly England was interested in the prosperity of the country. He knew that on such occasions politics must be avoided, but he could not help saying that he thought they must all feel some sympathy with this nation, which had been despoiled of one-third of its possessions, and had to pay a huge indemnity ; and for what ? In consequence of some accusations that had never even been proved. Even if the claims which were made on Siam were in any way justifiable, they might certainly have been made in a far more generous spirit than that shown by the great French nation. He could not understand their conduct, and knew of no excuse for it, except such as might be covered by the vague and general term of the advance of Western civilisation. It was only right, however, that England should look to her own interests in Siam. Mr. Leckie had told them how the British were perfectly willing competitors in trade where it was free alike to all parties, but when we had created a trade and developed to a great extent the prosperity of the country, he did not see why we should suffer another country to step in and, perhaps, propose some protective tariff, which would be the ruin of all connected with the trade. It might not be our business to interfere with the quarrels between one foreign country and another, but if we had created, by the industry of our subjects, a valuable stake, it would be pusillanimous to forego all exercise of power in resisting any inroads on that prosperity. From the terms of the treaty which were referred to, it was evident there were great fears for the future. The French had crossed the mountain barrier and taken the whole of that vast district, and had insisted that within sixteen miles of the right bank of the Mekong there should be no Siamese troops. Such a stipulation was quite unheard of in any foreign treaty, and he looked upon that particular clause as fraught with great danger in the future. They could not say what pretext might not be seized upon for further inroads on Siam, and we ought, therefore, to watch most anxiously any further steps taken by the French Government. Not long ago he read in a French paper that some gentleman in Paris proposed that the whole commerce of the Mekong should be

placed entirely under French control, and also that of the Semoun. That gentleman was not a Government official, but, to a certain extent, he represented French feeling. A war of tariffs was a great mistake for all parties. If the French would throw open the ports of Tonquin and Cochin China, they would benefit themselves as well as others. As had been shown in the case of Saigon some years ago, Cochin China was a flourishing colony; but then tariffs were introduced, with the immediate result of a decline, not only in general trade, but in French trade also.

Mr. F. W. VERNEY said he was precluded from touching on the political aspect of the subject, but it did appear to him that Siam appealed very strongly to the sympathies of the English people, on the ground of the continued and peaceful progress she had made for many years past, certainly during the reign of his present Majesty, and, indeed, for some time before. There was no trade thermometer so delicate, perhaps, as that which was afforded by the increase of the shipping interest as far as our own country was concerned. The other day, he got the first consular report he could lay his hands on, which was dated 1867, and found the total tonnage of British ships for that year, entering Bangkok, was 40,500. They had just heard that the tonnage for 1892 was 174,500 for the port of Bangkok. That fact alone was quite enough to arouse in the minds of British people a very strong interest in the commercial fate of Siam. The commercial fate of such a country was linked with its political existence, and with its integrity as an empire. Siam was not one of those conservative countries which tried to close its ports against all incomers. In many respects it had taken the lead in all peaceful progress, though perhaps it had not gone quite so fast, or entirely in the same direction which some of its English advisers would have wished, but, at all events, she had advanced, and had within her a potentiality of further advance, which no one who knew anything of the country could deny. There were several gentlemen in the room who had lived there for many years, and could speak from their own personal experience. He had only been there once for a few weeks, but that was quite sufficient to show him how many signs there were of progress, and they were all in the direction which Englishmen could sympathise with. Even apart from the selfish interest of England, Siam being by no means *une quantité négligeable*, from a commercial point of view, our politicians and statesmen ought to show great sympathy for the country and the people, as no doubt they would if public opinion were clearly expressed to that effect.

Mr. J. ANNAN BRYCE said it appeared to him that for the interest of England it was of the utmost importance that we show, in some practical way, our sympathy with Siam, and our determination that the encroachments already made by France should go no further. In these days of extreme competition in all

the markets of the world, and when the labour question was becoming so prominent a one, it was a matter of extreme importance that we should not allow to pass out of our control a single market in which we had a footing, especially one which was already of so great importance, and which had every promise of becoming more important still, not only for the trade of the country itself, but also for the fact that it furnished access to the regions beyond which they all expected some day to produce immense trade for this country. If, unfortunately, anything should happen to Siam, England would be blocked out altogether for access, not only to the country itself, but to the regions beyond, and we should therefore endeavour to assist Siam in every possible way to maintain herself at least in her present position.

Lord LAMINGTON said he should like to add one word, viz., that he thought what we ought to strive for was to obtain some joint guarantee for the integrity of Siam, that she should be allowed to work out her own course in future, unhampered by the fear of aggression. There was no doubt she had done a great deal in the past, and was doing a great deal now for her own development, and although at times traders and the Government must come into collision when nationalities were so distinct as our own and the Siamese, yet they must all agree that the Siamese did offer facilities for the opening up of their country, and if they were allowed to go on and work out their own salvation in their own way, without fear of their country being taken away piecemeal, there could be no doubt that English trade there would enormously increase.

The CHAIRMAN, on behalf of the Indian Section, begged to express to Mr. Leckie their great gratitude for this most interesting paper. He hoped its very practical nature would commend itself to the audience, and also to that large section of the British public which hitherto had been characterised by a most lamentable ignorance of everything in Siam. He must admit that he had personally received a great deal of instruction from it, and he should have been glad if many of his colleagues in the City had been present; at the same time, the paper, when published, would have a very wide circulation, and, he was sure, would be perused with very great interest.

Mr. LECKIE, in response, said he fully endorsed the remarks Lord Lamington had made as to the assistance the Siamese Government gave to the opening up of Siam to foreign trade. He should be very glad if the effect of this paper was in any way to arouse amongst the English people more interest in the matter.

General PRENDERGAST writes:—Mr. Leckie has pointed out to us the strong commercial position that

England has attained in Siam; has showed us British commerce was steadily increasing till uncertainty was produced by France; and warned us that, if France be allowed to control Siam, heavy import duties would soon destroy the trade of Bangkok, as they have killed the trade of Saigon. Lord Lamington suggested that some arrangement should be made between England and France by which the latter should be restrained from further interference in Siam—an excellent idea; but France already has Siam by the throat, and it is difficult to conceive any bribe that can be offered by free-trading England to induce France to relax her hold. I have not been to Siam, but I have studied the movements of France in Indo-China. Though I am not in a position to say what course should be pursued by England at the present juncture, I may, perhaps, be permitted to recall the events of 1885, when France was endeavouring to obtain control over the neighbouring empire of Burma. Arrangements were made by which the monopoly of railways, and banks, and the command of the trade of Upper Burma were to pass into French hands, and King Theebaw was persuaded to levy a ruinous fine from a British firm, with the idea of driving that firm from his dominions. In order to protect British interests, an expeditionary force was despatched to Rangoon. The war commenced on the 14th November, 1885; a fortnight later King Theebaw was deported a prisoner from his capital, and as China threatened to interfere, Bhamo, a frontier town, was occupied. On the 1st January, 1886, the Viceroy notified that Upper Burma had become part of her Majesty's dominions. Thus by showing a bold front, not only was the trade with Burma protected, but also a rich and fertile country as large as France was annexed to her Majesty's Indian Empire. At the present crisis, the interests of China seem to coincide with those of Britain, and Siam is the faithful friend of England, so it may be hoped that France may find it convenient to return to the paths of justice and peace, and to conciliate the great powers that are interested in the preservation of peace and of the autonomy of Siam.

Miscellaneous.

WOOD-PAVING IN MELBOURNE.

Baron Sir FERDINAND VON MUELLER, K.C.M.G., F.R.S., honorary corresponding member of the Society of Arts, has communicated a memorandum on the use of wood for street-paving with the following covering letter:—"Herewith, I beg to transmit to you a letter from Mr. Mountain, City Surveyor of Melbourne, in reference to experiences here with the wood-paving operations; and I have forwarded likewise the last annual report, issued by Mr. Richards, the City Surveyor of Sydney, containing information on the same subject. In some of the latest numbers

of the highly valuable *Journal of the Society of Arts* the questions, connected with wood-paving in the great Home Country, are discussed at some length, also in respect to Australian timber tried for wood-bricks. It may, therefore, be of interest to your important Society, and be worthy of record in its periodical, what successes have hitherto been obtained with wood-paving on this side of the globe, although the climatic conditions here, in a comparatively dry and winterless region, are very different to those of Great Britain."

"Memorandum to Baron von Mueller, M.D., F.R.S., K.C.M.G., Botanical Museum, Melbourne.

"Australian timber was first used as a material for street-paving in Sydney, N.S.W., where an experimental section (comprising several kinds of New South Wales hard and soft woods) was laid in August, 1880, under the direction of the writer, who was then City Surveyor to that city. The result of this test established the fact that several of the Australian hardwoods were well suited for street pavement. This example was soon followed by the City of Melbourne, the result being that at the present time these two great centres and their suburbs contain considerably over half-a-million square yards of paving composed of Australian hardwoods.

"At first the practice was to lay the blocks in rows with wide joints (from $\frac{3}{4}$ in. to 1 in. in width), but experience has shown that—with proper care during damp weather—the hardwood blocks on ordinary gradients gave good foothold to horses, and the width of the joints has been gradually reduced to $\frac{1}{4}$ in.; and, I believe, in Sydney the joint has been actually abandoned, and the blocks laid close together.

"In New South Wales, the woods principally employed on this work are:—Tallow wood (*Eucalyptus microcorvus*), Black Butt (*E. pilularis*), Spotted Gum (*E. maculata*). The various ironbarks, admirable as they are in strength and durability, are not used, being too valuable for wood-paving.

"In Victoria, the only locally-grown hardwood used on the streets, to any extent, is the Murray river red gum (*Eucalyptus rostrata*); but the West Australian Karri (*E. diversicolor*) has been introduced, and also the New Zealand Kauri pine, both of which timbers have answered well in the work. The latter, although not a hard wood, would appear to have a much longer life in the street than the Baltic or Memel pines used in England and the Continent for wood-paving.*

"The factors governing the wear of a road are so difficult to calculate, and the method of construction so liable to afford variable results, that it is hard to say, with certainty, how long Australian timber will last in a street. I think it is fair to assume that in a

* But the drier and winterless clime of Australia should, in such comparisons, be taken into account.—(F.v.M.)

street of heavy constant traffic (such as Flinders-street in this city, or George-street, Sydney), a thoroughly well-made wood pavement would last for from 12 to 14 years. This will mean sound, well-grown timber, free from sap or decay of any kind, laid on good foundation, and with thin joints. A bed of Portland cement (varying in thickness from 6 in. to 12 in., according to the nature of the foundation, finished off with cement rendering consisting of 3 of sand and 1 of cement) not more than 1 in. thick, to ensure a fair and even surface, is first laid. On this the blocks, varying in breadth from 7 in. to 9 in., 3 in. in thickness, and 6 in. depth (measured along grain of wood), after being dipped in hot tar and well drained, are laid down with close joints diagonally across the street. The joints are then sealed, by being "run in" up to the surface with hot tar, boiled for two hours, and no longer. A few mastic joints should be left occasionally, on account of swelling.

"A. C. MOUNTAIN, M.Inst.C.E.,

"City Surveyor.

"City Surveyor's Office,

"Town Hall, Melbourne,

"April 4th, 1894."

PATENTS IN 1893.

The report of the Controller-General of Patents, for the year 1893, has just been presented to Parliament. The number of applications for patents during the year exceeded that of any previous year, having amounted to 25,120, or an increase of about 4 per cent. above the number of applications in 1892. The number of applications has grown steadily since the Act of 1883. In 1884 there were 17,110; the next year, 1885, there was about 100 less, but with that exception the increase has been steady.

The greatest number of applications under the old Act of 1852 was in 1882, when the number was 6,241, or about a quarter of the present number. From 1852 to 1882 the growth had been almost continuous, and had increased from 2,764 in 1854 up to the number given above in 1882. The total number of patents sealed from the date of the passing of the Statute of Monopolies in 1623 down to the passing of the 1852 Act was 13,561. How far this enormous increase in patents for inventions represents any genuine growth in the inventive faculty it would be difficult to say.

The report notes that recent years show a considerable increase in the number of complete specifications filed with the applications, and that every year the number of applications accompanied by provisional specifications, which are allowed to lapse through omission to provide complete specifications, becomes relatively larger. The reduction in the scale of renewal fees, sanctioned in 1892, has caused

a small increase in the number of patents kept in force.

The number of patents which perish in the later stages seems to be as large as ever, and the proportion of those which die in the earlier stages appears to be increasing very rapidly. In 1877, 65·8 per cent. remained in force for three or four years. In 1892, the per-centage had dropped to 47·8, the decrease being fairly steady throughout that period.

It is a remarkable fact that more than half the patents applied for are now allowed to perish at so very early a stage in their existence. Of the applications of 1880, only 6 per cent., or 222 out of 5,717 applications (made under the 1852 law) still survive, having lasted the full period of 14 years.

So far as the tables enable a judgment to be formed, an equal per-centage of the patents taken out under the existing law survived to the later stages, although a much larger proportion perished in the first stage. For instance, of the 1886 patents, 15·4 per cent. are now in their eighth year, and the percentage of the 1877 patents alive at the same period was 14·2.

The applications for designs show a steady falling off during the past six years, and the same remark applies to the applications for the registration of trade marks. With regard to these, there was a steady increase on the passing of the Act in 1883 up to 1888, when 13,315 applications for registration were made. Since then there has been a steady falling off, the number last year being 8,675. The total earnings for the year amounted to £174,877. The surplus for the year was £79,774.

LEAVES OF TREES AS FODDER.

The United States Consul at Chemnitz, in a recent report, describes the experiments made by farmers on the Continent last year to feed their cattle on the leaves of trees. The French, he says, have taken the lead in the movement. They recommend exclusively the leaves of the hazel, aspen, ash, elm, and willow. The leaves, after being gathered, are spread on the barn floor to the depth of three to four inches, and are turned once a day. They dry in from three to five days, according to the weather. When dry they are piled up ready for use. It is profitable to prepare each day's supply 24 hours beforehand. There is mixed with the leaves to be served each day a small amount of chopped-up turnips, leaving the whole to ferment. Just before feeding, clover, hay, or lucerne is sometimes added. This food has been found especially good for milch cows. Young shoots and branches of trees, with their new leaves, are picked off every five years and fed to sheep. These animals are very fond of the aspen, because of its resinous and sweet buds. Willow leaves and bark mixed with

oats are regarded as a very pleasant, nutritious, and strengthening food for horses. It is not good to feed the leaves green; in fact, the cattle prefer them dried. Again, they should be served only with other fodder. When the leaves are young they contain a large quantity of nitrogen. As the season advances this grows less, as do also their nourishing properties. It is said that July and August, when the leaves are full grown, is the best time for harvesting them. Experiments were made with potato leaves, but the results were unsatisfactory. They should be used only in times of greatest scarcity, and only then to save the live stock. The potatoes deprived of their leaves suffer much more than is made up by their leaf value for fodder. The Consul concludes:—"All this trouble in Europe is taken to find substitutes and to save cattle, and yet 2,000,000,000 bushels of the best food for man and beast burden the granaries and barns of the United States. Why do not the European farmers take our maize? It is infinitely better than their best substitute, is one-third as dear as rye or wheat, and, in the testimony of their own chemists, almost as nutritious; though twice as dear as potatoes, it is more than four times as nutritious."

—The Times.

Correspondence.

ETYMOLOGY OF PEWTER.

I feel it is impossible to accept the ingenious suggestion made by Mr. J. Starkie Gardner, in his fascinating paper on pewter, that the name of this alloy of zinc and tin is a double of, or, at least, derived from a common root with, "potter." There are links wanting in the history of the origin of the word "pewter," but there can be no real doubt of its being a double of "pelter," through the Italian *peltro*, and French *plautre*, from the yet older English "spelter," or zinc. The earliest records of the form pewter are in the *Promptorium Parvulorum sive Clericorum*, 1440:—"pewtyr; metalle" and immediately after in the *Catholicon Anglicum* [ed. Sidney T. Heritage], 1483:—"pewdyr; electrum."

May I add how deeply I regret not to have been able to be present at Mr. Starkie Gardner's lecture, and the expression of my earnest hope that it will serve to promote a revival in this country of the once thriving manufacture of artistic pewtry.

GEORGE BIRDWOOD.

India-office, 2nd June, 1894.

Obituary.

DR. C. H. PEARSON.—The distinguished historian, who had promised to read a paper before the Foreign

and Colonial Section of the Society on "Education in Victoria," died, to the great loss of the Colony of Victoria, and of the learned world generally, on the very day (May 29th) upon which the paper was originally announced to be read. Charles Henry Pearson, LL.D., was the fourth son of the Rev. John Norman Pearson, and was born on September 7, 1830. He was educated at Rugby and Exeter College, Oxford. Here he obtained a first-class in the Final Classical School in 1852. He determined to enter the medical profession, and for this purpose studied medicine in Edinburgh for one year. Bad health, however, compelled him to give up this intention, and he returned to Oxford, where he was shortly afterwards elected a Fellow of Oriel College. He subsequently became Professor of Modern History at King's College, London, and acted for some years as Examiner in History for the Civil Service. In 1861 he published his history of the "Early and Middle Ages of England," which earned him a high reputation in this field of historical study. Again, however, his health broke down, and in 1863 he left England for South Australia, where he devoted himself to agricultural pursuits. Subsequently, he migrated to Victoria, where he entered into political life, becoming a member of the Colonial Parliament and ultimately Minister of Public Instruction. The University of Glasgow gave him the honorary degree of LL.D. in 1889. In 1892 his health once more showed signs of failure, and, after a severe attack of influenza, he was obliged to leave Melbourne for England. Shortly after his arrival he was appointed secretary to the Agent-General for Victoria, in which capacity he acted till his death. His important book on "National Life and Character" was published rather more than a year ago.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JUNE 11... British Architects, 9, Conduit-street, W., 8 p.m.

TUESDAY, JUNE 12... Asiatic, 22, Albemarle-street, W., 3 p.m.
Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Photographic, 50, Great Russell-street, W.C., 8 p.m.

1. Prof. Marshall Ward, "The Action of Light on Bacteria and Fungi." 2. Mr. W. J. Wilson, "The Development of Printing-out Papers." Anthropological, 3, Hanover-square, W., 8½ p.m.

WEDNESDAY, JUNE 13... Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

THURSDAY, JUNE 14... Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Mathematical, 22, Albemarle-street, W., 8 p.m.

FRIDAY, JUNE 15... United Service Institution, Whitehall-yard, 3 p.m. Mr. H. Lawrence Swinburne, "The Differentiation of Naval Force—a Comparison."

Queckett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, JUNE 16... Zoological, Regent's-park, N.W., 3 p.m.
Mr. F. E. Beddard, "Sketches in Geographical Distribution." (Lecture V.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

ALBERT MEDAL.

The Council of the Society of Arts have, with the approval and sanction of the President, H.R.H. the Prince of Wales, awarded the Albert Medal to Sir Joseph Lister, Bart., F.R.S., "for the discovery and establishment of the antiseptic method of treating wounds and injuries, by which not only has the art of surgery been greatly promoted and human life saved in all parts of the world, but extensive industries have been created for the supply of materials required for carrying the treatment into effect."

MEDALS.

The Council have awarded the Society's Silver Medal to the following readers of papers during the Session 1893-4:—

To LEWIS H. ISAACS, for his paper on "Carriage-way Pavements for large Cities."

To W. WORBY BEAUMONT, for his paper on "Automatic Balance of Reciprocating Machinery, and the Prevention of Vibration."

To G. J. SYMONS, F.R.S., for his paper on "Rainfall Records in the British Isles."

To PROF. VIVIAN B. LEWES, for his paper on "London Coal Gas and its Enrichment."

To CHAPMAN JONES, for his paper on "Some Recent Developments of Photographic Chemistry."

To JOHN A. GRAY, for his paper on "Experiences at the Court of Afghanistan."

To SIR AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., for his paper on "Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh."

To C. S. LECKIE, for his paper on "The Commerce of Siam in Relation to the Trade of the British Empire."

To EDOUARD SÉVE, for his paper on "The Antwerp Exhibition, 1894."

To JAMES INGLIS, for his paper on "New South Wales."

To PERCY FITZGERALD, M.A., for his paper on "The Adam Architecture in London."

To HENRY BALFOUR, M.A., for his paper on "The Evolution of Decorative Art."

To J. STARKIE GARDNER, for his paper on "Pewter."

Thanks were voted to WILLIAM HENRY PREECE, C.B., F.R.S., Vice-President, for his paper on "Electric Signalling without Wires."

CONVERSAZIONE.

The Society's *conversazione* will take place at the Imperial Institute, South Kensington (by permission of the Council of the Institute), on Friday evening, June 22, from 9 to 12 p.m.

The reception will be held from 9 to 10 p.m., in the vestibule, by Sir Richard Webster, G.C.M.G., Q.C., M.P., Chairman; Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Deputy-Chairman, and the members of the Council of the Society.

Each member is entitled to a card for himself, which will not be transferable, and a card for a lady. A limited number of tickets will be sold to members of the Society, for the use of their friends, at a charge of five shillings each, if purchased before Saturday, 16th June, after that date the price of tickets will be raised to seven shillings and sixpence. Tickets can be obtained on personal application at the Society's house, or by letter addressed to the Secretary. In all cases of application by letter, a remittance must be enclosed. Each ticket will admit one person, and must be signed by the member to whom it is issued.

Promenade concerts will be given by the Band of the Grenadier Guards in the West Gardens, by the Band of the Royal Artillery in the Indian Pavilion, and by Ashton's Blue Hungarian Band in the Vestibule, from 9 p.m.

Those travelling by railway to or from the Imperial Institute will be allowed the free use of the District Company's subway, which leads from South Kensington Station to within a few yards of the Imperial Institute road.

The cards of invitation have been issued to members.

Proceedings of the Society.

FOREIGN AND COLONIAL SECTION.

Friday, May 25, 1894; FRANCIS COBB, Treasurer of the Society, in the chair.

The paper read was—

THE INDUSTRIES AND PROSPECTIVE SOURCES OF WEALTH IN NEW SOUTH WALES.

BY THE HON. J. INGLIS, M.L.A.

President, Chamber of Commerce, Sydney, N.S.W.

I have been invited to address this honourable and learned Society on the industries of New South Wales. That colony is a world in itself. Its natural riches are so vast and varied that the bare summary of them would exhaust the space at my disposal. The second century of its settlement has not yet entered even on its "teens." Its area could comfortably include nearly the half of Europe, and its population is barely a million and a quarter. The climate and soil are favourable to the cultivation and growth of all European and many sub-tropical field and forest products. Its mineral wealth is as varied as it is exhaustless. The people possess a political and religious freedom nowhere excelled in the world. This has naturally influenced the national character, so that one is led to expect a frank self-consciousness, a fearless independence of thought, a robust, vigorous self-reliance, an acute keen-witted inventive faculty, quickly adaptive, impatient of restraint and careless of conventionality. An ingrained love of freedom and respect for government, a full-pulsed joyous physical life, and a loyal attachment to the best traditions of the country and kindred, whence sprang their life, and to whose wise liberality and brave example they so largely owe their own magnificent inheritance and priceless freedom.

If occasionally there are ebullitions of a short-lived bumptiousness, if political problems find solution with a rapidity that startles home-grown Conservatism, and begets the fear that the solution may be less real and stable than apparent and evanescent; if the purely material and physical may, to friendly eyes, appear at times to preponderate, to the detriment of the intellectual and spiritual elements in the tone of society or the constitution of the commonweal, yet, though we know not what modifications the future may bring, I do honestly believe, speaking as a fairly impartial and observant man, that the character of the people is very much as I have thus rapidly and imperfectly tried to outline it; and now, having thus broadly sketched what is the country and what are the people, let us, during the short time at my disposal, endeavour very briefly and summarily, to see what is being done to develop the one by the enterprise, the industry, and the genius of the other,

In the early stages of settlement, when land is cheap and abundant, labour dear and scarce, communications difficult, and all the common processes of life primitive, the cheapest crop, and the one that can be best and quickest utilised, is the natural wild one—the pasturage of the country. The grassy plains and open spaces are the first to invite settlement. The flock master and the shepherd are the pioneers of progress. There is not much scope of demand for the handicraftsman. Men acquire a versatile deftness in wielding axe or saw, using whip or gun, driving oxen or breaking in horses—improvising ingenious but rough make-shifts and aids to labour, and life generally is on the hand-to-mouth, rough and tumble, scurry and scramble, sufficient-to-the-day-is-the-evil-thereof principle. But competition at first is rare and rewards are munificent. There is a plenitude of natural wealth. A boundless treasury of choice. A reckless prodigality of supply, which too often begets a criminal wastefulness, and a lazy, indolent acquiescence in modes of life and habitudes of thought, which lead to self-indulgent complacency; to a class exclusiveness, the worship of wealth and mere material prosperity, and in the end are very relaxing to true manly moral fibre. This is the story of early settlement in most countries where the Anglo-Saxon has reclaimed the wilderness and carved out of "the waste places of the earth" a copy more or less exact of the old mother land, with its constitution, its laws, its customs, and observances, aye even in many cases its prejudices, blemishes, and defects.

All industry thus at first centres round the rearing, tending, and disposal of stock. The land is selected not so much for its arable value as for its stock-carrying capacity. The "talk is of beeves," of strains and crosses of blood, and of mutton and wool, and tallow and hides. Men live in the saddle. In search of "pastures new," they develop nomadic traits. Vast movements of flocks and herds perpetually occur. Pasture and water determine the site of settlements, the drover or overlander, the stock and station agent, the overseer and boundary rider, the shepherd and the shearer, the fell monger and the wool sorter, the sporting butcher and the speculative jobber, the saddler, publican, blacksmith, and bush wheelwright, are the prominent characters of the primitive society, and all deal more or less in stock. The very banker, doctor, lawyer, and parson are learned in the literature of the stud-book, become wise with shepherd lore,

and literally in season and out of season "return to their muttuns" and exercise their wits in "wool gathering."

First and foremost then stands the great primal pastoral industry, the production of beef and mutton, of hides and wool, with all its allied pursuits and ramifications. You can thus understand how important a part is played by climate and rainfall in the industrial economy of the people. I need not weary you with figures, but some faint idea of the magnitude of the interests involved may be gained from the fact that an increase or decrease in the price of wool for one season of one penny either way, means an additional revenue to the country of over £1,000,000 sterling in the one case, or a diminished spending power of a like sum in the other.

The normal census of our flocks shows a total of from 55,000,000 to 60,000,000. The annual surplus available for slaughter and export is estimated at from 8,000,000 to 9,000,000. Strenuous efforts are now being made to make this enormous food supply available to your working populations here, on the Continent, in our Eastern dependencies, and, indeed, wherever good, succulent, cheap mutton—either tinned, chilled, or frozen—is likely to find appreciative consumers. Beyond a doubt the meat is delicious and nourishing, and it can easily be sold here at 6d. to 8d. per lb., or even less, so as to leave a handsome profit to producer and retailer, after paying every possible charge from the pastures in far Australia to the workman's table in any part of the United Kingdom. The pastoral industry, too, is becoming more consolidated and scientific, so to speak. The nomadic stage is past. Lands are being constantly improved, and their carrying capacity augmented. Fencing, clearing, laying down with artificial and improved herbage, and conservation of water, have received great attention within the last decade or two. Small graziers abound where formerly great shepherd kings held sway. The great wool sheds are models of careful adaptation of means to an end, and are replete with every ingenious, labour-saving appliance devised by long experience and brilliant inventive skill. The reign of crude appliances and wasteful methods is over. The discovery of artesian water in the west, and the conservation of natural supplies in other parts, the clearing of forests, reclaiming and draining of marsh lands, and improvements everywhere, have made the great pastoral properties on all sides more valuable. It is silly and

misleading then in the extreme to listen to the miserable bleating of some of our bilious critics, who try to smirch our credit by saying that the banks have lent money on valueless pastoral properties, and that the pastoral industry is doomed to decay and death. Wherever money has been advanced on pastoral properties, it has been advanced on land mainly, and on flocks and herds only as a collateral security. The land, as I have shown, is augmenting in value, and in no case, so far as I know, have advances been made without an absolutely safe margin—in most instances fully double the amount of the advance. I believe the great pastoral securities of the banks are absolutely safe, and already signs of the turn of the tide are apparent; and long ere the deposits are due for re-payment in the case of our re-constructed banks, the fabric of our financial and commercial prosperity will be as strong and buoyant as ever it was, and once more we shall have shown to the world, that Anglo-Saxon enterprise and industry never knows when it is beaten, and that just when most it seems overwhelmed with disaster, is the moment when, touching bottom, it gathers strength for its next upward spring and onward effort, taking it farther out than ever on the placid sea of prosperity and beneficent progress.

Britain need not be afraid of her boys. Sure I am the boys are well able to take care of themselves, and if ever the time should come, would not withhold a loving, helping hand to the dear old mother land in her time of need.

So far as new conquests of fresh territory, however, are concerned, the pastoral stage may be said to have reached its limit. New South Wales will always remain a great pastoral country, perhaps the greatest on the face of the earth; but we are now fairly launched on the second great stage of a nation's development.

THE AGRICULTURAL STAGE.

On every hand farming is advancing by leaps and bounds. Mixed farming is the rule in Australia. Our farmers, or selectors as they are called, do not put all their eggs in one basket. Every large selector not only grows wheat and other cereals, but breeds horses and cattle, and keeps flocks of sheep as well. Agricultural and pastoral societies exist in almost every electorate; every country town of any size holds its annual agricultural show, at which there is keen competition for

good prizes in every department of stock-breeding, and in all the minor industries that naturally spring from farming. The judging is entrusted to highly-qualified experts; Government assists with liberal subsidies. Trading firms take full advantage of the opportunities thus afforded for displaying every conceivable novelty in implements, machinery, and the various requirements of high-class modern farming.

Let us examine the show ground of one of these Australian associations.

Space is ample, for land as yet is cheap, clumps of willows fringe the water-course, and their vivid green contrasts refreshingly with the funereal, plummy foliage of the casuarinas, or river oaks, and the sombre uniformity of the omnipresent gum trees. The grass is dun-coloured and wiry. The face of the earth is littered with bark, withered leathery leaves, and twigs and broken branches innumerable. A hot sun darts down shafts of quivering heat, and a hum of insect life and the strident staccato of the ubiquitous cicada fills the air with a ceaseless din, which dominates even the motley chorus of the show beasts which have come from all quarters to compete for the liberal prizes which the committee has provided. All round the enclosure are roomy pens substantially built of brush timber. Those for prize rams and stud sheep are generally roofed in with slabs of bark or corrugated iron. A spacious pavilion stands in the centre of the ground, and there are the usual refreshment booths, side shows, and exhibits of machinery and merchandise.

One of the favourite distractions is the horse parade and jumping contests. In one pavilion may be witnessed a trial of skill by expert shearers on live sheep to demonstrate the respective merits of rival clipping machines. Models of quartz-crushing batteries are shown at work, as well as machinery of all sorts suitable for the various rural industries of the district.

A splendid collection of minerals, fossils, &c., from the Department of Mines, under charge of a qualified well-trained officer, attracts crowds of eager sightseers, all athirst for knowledge, which is most intelligently communicated by the officer in charge.

In like manner specimens of native and foreign grasses, grains, fibres, seeds, fruits, &c., all capitally mounted and intelligently arranged afford most practical object-lessons, and are in fact doing solid useful work in the direction of technical education.

In the main pavilion are found dairy exhibits of all kinds, with dairy furniture of the best modern types. Honey, wax, and everything appertaining to the apiary. Saddlery, whips, vehicles, furniture, and other products of local make, showing the progress that is being made in technical industry. Fruit, preserved in a dozen different ways. Vegetables of abundant variety and excellence. Samples of farm produce, as varied as the wide range of climate so bountifully allows, lie heaped up in ordered and tempting array on every hand. Wines, cordials and liqueurs, aerated waters, and potables of the most heterogeneous character, with a brilliant display of flowers of every hue, illustrate the richness of the districts' resources, and the wide range of productive enterprise open to the industrious and energetic settler. Under the mottled shade of the trees, on every knoll, and in every hollow, happy family parties are making jovial picnic. All are well fed, and possessed of unfailing good humour, and exhibit hearty hospitable proclivities all around. Possibly the costumes might strike one as a shade different from those of Pall-mall and Piccadilly, but not even in these favoured haunts of fashion could you find more lithe, athletic, well-made men, or merrier, bright-eyed, intelligent, comely women. There is an air of *gay abandon*, of light-hearted, sprightly, unconventional exuberance and animation, which speaks volumes to the watchful observer, and tells of a life free from many of the carking cares of our older civilisation; of a climate which is stimulating, and an environment about which very few shades of suffering discontent or privation, have as yet, at all events, had time to gather.

The town, encircled with wooded hills, lies behind the show ground. There are the spires of Anglican, Roman Catholic, Presbyterian, Wesleyan, Congregational, and other churches. The Salvation Army is well represented you may confidently believe, and very likely the Free Thinkers and Secularists, and, indeed, every sect or organisation of a religious, philosophical, or socio-political character known to the Anglo-Saxon race. Prominent among the institutions of the town, no matter though the population be less than that of many an English village, you may depend upon it, is the district hospital, the school of art, the mechanics' institute, and most likely a temperance hall, a Masonic temple, and some other hall or building sacred to the Foresters, Druids, Odd Fellows, or other friendly society. The Government liberally subsidises the hos-

pitals and schools of art, but private subscriptions flow with perennial liberality, and a generous public spirit is always *en evidence*. Then there are the usual political organisations, protectionists, free traders, single taxers, socialists, unionists, and employers' associations. Be sure the well-appointed race-course, the cricket ground, the public park or recreation reserve are absolutely essential to the very being of the settlement; while the public spirit and advanced intelligence of the community has noble testimony borne to it in the presence of the public school in some commanding and central position. The schools of New South Wales are in no respect behind the best in England or Germany, whether in structural design, in furniture and appliances, or in the trained staff, in whose hands lies the administration of one of the best Education Acts known to our race, and which we owe to the genius of our veteran statesman, Sir Henry Parkes. It is a pregnant fact that with a population of less than a million and a quarter, a sum of nearly £700,000 sterling is annually expended on public education.

Now this necessarily brief and I fear somewhat dull summary, if any one reads between the lines, and tries to grasp the significance of the bold facts I have stated, is surely sufficient to show what sort of a national life is springing up, and what sort of an industrial and intellectual order is being rapidly formed under the starry splendour of the Southern Cross.

As concrete examples of many of our industries, showing what conditions exist and what developments are being evolved, let me ask your attention for a moment to a rapid *résumé* of three typical channels of production, always remembering that these are but types of many such which my space forbids me from detailing at length.

THE FROZEN MEAT, THE DAIRYING, AND THE WINE INDUSTRY.

The squatters or large pastoralists, owing to successive falls in the price of their chief staple, wool, the gradual pressure of advancing population which limits their grazing area and forces them to make better use of what remains; the burden of interest on the large capital which has been expended in acquiring a freehold tenure, and in making extensive permanent improvements; the demand of the powerful and educated democracy for a larger contribution to the revenue, as rent, in exchange for the liberal expenditure made by

the State on roads, bridges, railways, and other public works—a demand, which was inevitable, and which the most sensible among the squatters clearly foresaw; the increase of the rabbit pest and other causes, have all contributed to handicap the pastoral industry to some extent, and make it a less profitable pursuit than in the early days of which I spoke at the beginning of my paper. So far, however, from being cowed and disheartened, the pastoralists have shown a splendid fortitude and a virile energy, and one outcome of their awakened enterprise is the establishment of the frozen and chilled meat industry.

Given the hungry masses of these older crowded lands, the splendid improvements in marine architecture and the marvellous revolution in commercial navigation, it was certain that thoughtful men should seek to solve the problem of how the superabundance of food at the Antipodes could best be utilised in feeding the hungry at this end of the earth. I have not time to detail the patient experiments and strong faith which led on such men as Mort and others till the problem was at last solved. But you all know that now the flocks and herds of Australia are being bred just as much for your tables as for the tables of Sydney or Melbourne. Formerly no better use could be found for surplus flocks than to kill them for their skins, and boil them down for their tallow. Now, the most progressive amongst our flock masters, and I particularly wish to name my friend, Mr. F. Featherstonhaugh, are co-operating to still further improve the breed, so as to produce larger carcasses. Chilling works are being erected in most of the great pastoral centres. Depôts for frozen meat are in existence close to the wharves at Sydney, Newcastle, and at nearly every port in New Zealand. The enhancements of value to the grazing industry of New Zealand has run into millions. The same results will undoubtedly be achieved in New South Wales.

We are seeking to tap the markets of the Orient, of England, and the Continent. The consumption is so enormous, that your home-grown beef and mutton and dairy products can always command top prices for as much as your farmers can raise, but there is no reason, except stupid prejudice, why the armies of Europe and India should not be fed with succulent Australian mutton, nor why your vast armies of industry, and the masses of your great cities, should not be abundantly and cheaply provendered from the same ex-

haustless source. Indeed I am now informed that already large contracts for tinned meats have just been concluded with Germany for her army and with France for her navy. It is to be hoped our Indian Commissariat, and the Horse Guards and Admiralty as well, will not need much spurring to follow such a good example.

The problem of production, of preservation, and of carriage has been largely solved. Let the same energy and plucky, intelligent enterprise be brought now to bear on the problem of distribution, and though possibly a few interested or hostile rings and monopolies may have to be overcome, victory is bound, at no long distant period, to crown the efforts of those who only ask you, the consumers, to avail yourselves of the obvious advantages of a cheap, abundant, accessible, and excellent supply, such as our producers and shipping companies now can place within your reach.

The story of our dairy industry fully justifies such a hope. It illustrates, too, the force of this recent industrial revival, and the immense potentialities that attend intelligent co-operation, and the application of improved processes to the natural industries of Australia. The annual consumption of butter in Great Britain is estimated at some 5,000,000 cwt., or 250,000 tons, and your home farmers cannot produce anything like that quantity. In New South Wales, the production was so much in excess of the demand that tons of good butter were every year allowed to go bad, and vast quantities were sold to confectioners, pastry-cooks, and others, at prices which really represented not half the cost of production. The market was always glutted. Farmers were at the mercy of agents, got discouraged, drifted into slipshod ways, allowed the standard of excellence for dairy cattle to deteriorate; and, as late as 1891, scarcely a single pound of butter or dairy produce was exported from the colony. But the principles of co-operation were slowly making headway. Adversity was teaching its bitter but salutary lesson. The use of the separator was beginning to become known, and now there are scores of creameries, butter and cheese factories, bacon curing establishments, and farmers' co-operative societies, all doing a sound, remunerative, and progressive business; and from a most interesting article in that admirable journal, *The British Australasian*, of May 17th, written by their Special Produce Commissioner, I learn that the imports from Australia and New Zealand into your market, from last

October to this present month of May, is 11,754 tons, or "more than one-tenth of the whole import of butter from every source in 1893."

This is a result highly creditable, I think, to our New South Wales farmers. They want no "coddling," no bounty system. At a recent meeting in Sydney, one of their most representative men is reported as saying, "It might be said that Victoria had the advantage over us in New South Wales in regard to the bounty system; but he hoped no one here engaged in the industry would go cap in hand to the Government for similar privileges or bolstering up." The manly sentiment was received with cheers. The pernicious system of Protection smuggled in by the present New South Wales Government, some two years ago, on the specious pretext of fostering native industry, has only had the result, as far as I can see, of imposing a penalty of some hundred pounds or more, on all the farmers' co-operative societies who have started creameries; that sum representing the duties levied on the machinery, which cannot, at present, be made in the country; in spite of this, however, the dairying industry is progressing with swift and steady strides; and the lesson of co-operative action, and taking advantage of improved appliances and the teachings of experience, is being learned with splendid results as regards the present, and with bright prospects as regards the immediate future.

The same lessons must now be learnt by our *vignerons*. Our wine industry has in it the germs of future wealth for the country beyond the wildest dreams of the most sanguine. The vine, in parts of New South Wales, grows with a luxuriance that must be seen to be believed. In the west, in the south around Albury, in the north, all along the rich valley of the Hunter river, on the sunny slopes of the coastal valleys—grapes are produced that will vie in flavour and quantity with the produce of the most favoured wine districts of France, Germany, Spain, or Italy. But our appliances are rude; our methods are, in many cases, primitive. The grape juice has in it every property necessary to the production of the choicest wines that could gratify the palate of the most exacting epicure. For ordinary wines our vineyards are capable of supplying the world with a wholesome, cheap beverage, such as would be the envy of our Continental brethren. But here, co-operation and capital are necessary. Grape growing is one thing, wine making is another. Were central

depots to be established in wine-growing districts, where the cultivators could be sure of a certain market in all seasons, the area of land under grapes could be a hundredfold increased. The purchasing company would supply the necessary cellarage and skilled manipulation, and I make bold to say that there is the promise in this direction of a return for capital invested, far exceeding even what is expected by excited investors in the most extravagantly bepuffed gold and silver mines. The individual grower cannot afford to wait for his returns; he cannot afford to put up extensive cellarage; he is not acquainted with the best processes, so he is obliged to sell his new wine before it has had time to mature. He thus does least justice to the intrinsic merits of the product of his industry. Wine-making is only in its infancy in New South Wales. It wants co-operation, and the aid of experts; but it has a future, in my opinion, as promising as that of any industry in the world.

Exactly the same remarks are applicable to our sugar growing, our coffee planting, our tobacco farming, and countless other products, for which our soil and climate are so well adapted. What the farmer most needs to learn, not only in New South Wales, but even here in England, is how to apply knowledge and effect economy in all his processes. It is not enough to grow prolific crops. The man who can most cheaply, and in the best or most concentrated form, get his product to just the market that is readiest inclined to buy, is the man that will make the most out of his industry. So for years I have been preaching to our farmers in New South Wales the necessity for concentrating produce on the farm, so as to cost least for carriage, to conserve for home use the largest quantity of waste or by-products, which are unsaleable perhaps at a distance, but which are of immense value to the farmer on the spot, and in this direction I feel sure is the revival of rural and agricultural prosperity to be looked for.

For instance, I have advocated that our farmers should vary crops more than they do. Tryoil seeds in rotation with cereals. An oil mill can be had for a small sum. The oil can find a ready sale at any port of shipment. It is easily transportable, occupies less bulk than the crop itself. The oil-cake is retained as a valuable seed food product and consequent fertiliser, and the waste otherwise goes back in various ways to hearten again the soil from which it has been taken. This central mill system, division of

labour, intelligent co-operation is the golden key to unlock many a problem that now is vexing the soul of the struggling farmer, and the sooner it is learned the quicker will prosperity return. It is being rapidly learned by the farmers of New South Wales. The applications are as obvious as they are endless.

Now if time served and your patience lasted I might advert to our fruit industry, our increasing production and export both of fresh and dried fruits, of our canneries and jam factories. We produce the fruit and the sugar too, and under a more enlightened fiscal policy we could supply the world. There are our fisheries, to which increasing attention is being given. Our tanneries, boot factories, and potteries. Our magnificent hard woods and timber, not excelled in any country of the world. Our fibres, drugs, dyes, and other vegetable products; but I must say a word or two in the short time left at my disposal on the teeming wealth of our mines and the extraordinary variety and richness of our mineral deposits.

A stroll through the excellent museum attached to our Department of Mines in Sydney, would warrant the use of the most superlative language in describing our mineral wealth. In diamonds, emeralds, rubies, opals, and other gems, I do not think we need lower our colours to any known gem-producing country, not even to Ceylon, the pearl of the East, and the far-famed Island of Gems. Certainly, the pearl shell fisheries on the northern Australian coast are about the richest in the world. At Bingera, in New South Wales, and in other localities, I believe we have just as rich diamond deposits as any that have been found in South Africa. Mr. A. S. Low and party are now searching systematically for the lower and richer drift by the aid of the diamond drill, and they will, I believe, achieve success, and reap a rich reward for their enterprise and outlay.

Our gold industry is now entering on a fresh revival. Better methods are being employed. The most perfect appliances are taking the place of the crude, clumsy machinery of a more primitive time. In more than one locality companies have been formed, armed with Parliamentary authority, to utilise water power, hitherto running to waste, in the production and application to the mines of electric energy, thereby cheapening and increasing the output very materially. Of course, the application of this new force will not stop short at mining. The total gold product of the colony up to the last year recorded,

namely, to the end of 1892, was roundly £39,000,000.

Our silver deposits are known to all the world. Who has not heard of Broken Hill? But that is only one out of many argentiferous centres. The production of silver and silver lead, up to the same year as last quoted, was £14,000,000, and it is now at the rate of £2,500,000 a year.

Tin, for the same period, £6,000,000.

Copper, £3,500,000.

Coal, £27,000,000, being now at the rate of 4,000,000 tons a year.

Of iron we have rich deposits, contiguous to limestone and coal. In time, it is a certainty we shall have a black country of our own.

Of less known minerals, I might mention the extraordinary rich deposits of natural pigments—red, white, purple, and yellow oxides. In fact, we have them in vast beds of almost every colour, and, as may be seen from the samples I have with me, of exceeding brilliancy and purity. They are, in fact, natural paints; they need little preparation, can compete with the best colours in this market, at a great reduction in cost, and if we could only overcome the conservative prejudices of the trade, they are destined to become, as they deserve to be, a very important element in our future trade relations with the outside world. These paints and colours are now being extensively used for large Government contracts in Queensland and New South Wales, by the railway and other departments, and the London agents, R. H. Gate and Company, of 28, Gracechurch-street; or Walter S. Hindley and Company, of Queen-street, can afford every information to any interested inquirer.

Of alum, which is so much used in various arts and manufacturing processes, we possess a veritable mountain at Bullahdelah, near Port Stephens. The deposit has only recently been opened up, and contains an average of 80 per cent. of alum. Works have recently been started here in England for the treatment of the alumite, resulting already in regular weekly shipments.

Of coal we are assuredly the most richly endowed of all the colonies of Australia. This valuable mineral is widely distributed, and consists of almost every known variety, from ordinary lignite, steam, and gas coal, to the rich cannel coal and petroleum shale of which vast deposits are known and have been profitably worked for many years. The principal coalfields hitherto worked have been at Newcastle, at the mouth of the Hunter, and for

some distance up that fertile valley. Of late years the southern coalfields at Bulli and along the Illawarra coast district have been creeping up on Newcastle, owing to the cheaper working of the coal and its greater suitability for steamships. These two opened districts, Newcastle on the north, and Bulli on the south, are the terminal outcrops of a vast carboniferous bed or basin, which extends the full length of the distance between the points. All geologists have agreed that the coal measures underlie the populous city of Sydney, with its splendid stretch of harbour, and several attempts have of late years been made to verify, practically, this confident assertion of the scientific theorists. One can see at a glance how vastly important to the numerous lines of great ocean steamers that make Sydney their terminal port would be the proximity of a bountiful and cheap supply of good steam coal, which could be raised beside the wharf as it were, and put into the ships' hold without any intermediate handling or expense, direct from the pit mouth. So important was the settlement of this scientific guess thought to be, that the Government contributed pound for pound to a plucky syndicate, that had begun boring operations with the diamond drill, to practically test the truth of the matter and settle the question. After much anxious work and large outlay, the magnificent seam was struck, at a depth from high-water mark of not so much as 30 feet within the exact depth which had been predicted by the geologists—a most happy and valuable verification, indeed, of the truth of scientific induction.

The importance of this discovery to the port, trade, shipping, and manufactures of Sydney cannot be over-estimated. Yet we have sceptics of such a character as the gentleman who, in criticising my address before the Royal Colonial Institute last month, used such words as these:—"Just fancy," he said, "what it will cost to sink for and get coals from a depth of 2,700 feet, about five-eighths of a mile." "Certainly all the export trade," he proceeded to say, "will be still supplied from the Newcastle and Southern mines, and until they are exhausted or sunk to this depth (which will take centuries to accomplish), he thought this wonderful seam on the shores of Port Jackson would in no wise realise my expectations." This is an instance of how "A man's worst foes may be those of his own household." If we have a retired Sydney merchant thus unbelieving and scorn-

ful, how can we complain of those who are perfect strangers to our resources and the character of our people to do anything except largely discount our utterances, and make a mock of our truest descriptions.

Happily, however, the verity of this momentous discovery, and the incalculable potentialities which it involves, are based on such authoritative deliverances as to compel the belief of every practical-minded and reasonable person.

It is a commonplace in the history of British coal mining to profitably raise coal from even greater depths than this. The Royal Commission on Mines, surely a sufficient authority, has laid down 4,000 feet as a workable depth, whereas this pit, on the verge of Sydney Harbour, right in the heart of the shipping, and within cable's length of wharfage facilities sufficient for the biggest steamer that has ever yet been built, will be only 900 yards. In Belgium, seams of only 2 ft. to 3 ft. in thickness are profitably being worked at this moment at a depth of 1,200 yards, and the Sydney seam is some 10 ft. thick, instead of only two or three, as in Belgium.

Professor Edward Hull, F.R.S., &c., author of that standard work, "The Coal-fields of Britain," speaks of this discovery as "one of the most remarkable experiments in boring for coal ever carried out in any country." The splendid core, three and a half inches in diameter, is now here in London, at the offices of the Agent-General for the colony, and is well worthy the inspection of any of the members of this learned Society. I shall be glad to accompany any who may wish to inspect it.

Professor Hull, speaking of "the depth at which the Cremorne seam has been reached," says, "it is by no means exceptional in some mining districts, as in Belgium, England, and South Wales." "Coal is worked," he says, "in Lancashire and Cheshire at 3,000 feet and upwards, and within the next few years the depth will be increased." "Nor will the temperature," he proceeds, "prove any obstacle to successful mining." A conclusion in which he is supported by actual experiment, carried out by Professor David, of Sydney University, and Mr. Slee, the practical experienced Superintendent of the Diamond Drill Branch of our Mines Department. Mr. Robert L. Jack, the well-known Government geologist of Queensland, has also independently come to the same conclusions. Professor Benton, late professor of mining engineering

in Mason's College, Birmingham, and himself a practical and successful colliery manager, still further confounds my amiable sceptic by saying—

"During my four years' residence in Sydney, the boring was begun in search for coal on the northern shore of the harbour, and, since my return to England last year, coal has been discovered. I have seen, at the office of the Agent-General of New South Wales, London, the coal extracted from the bore-hole. It is the Bulli Seam, having a thickness of more than 9 ft. of clean, hard, almost smokeless coal, equal in steaming value to any coal in Australia.

"Sydney Harbour is Crown property, but the whole area of mining value—7,000 to 10,000 acres—has been leased to the Sydney Harbour Collieries Company for perpetuity, with an annual minimum rent of 1s. per acre, on account of the tonnage royalty of 6d. for large coal, and 3d. for small coal. The lease is remarkable for its brevity, simplicity, generous terms, and enormous area, an area which will probably engage the lessees for 200 years, with half a million tonnage annually.

"The site chosen in the harbour for the pits at the head of the Military Reserve, Mossman's Bay, is well known to me. It is free from all buildings, has sandstone cliffs 40 ft. high, and affords an easy site for coal staithe, colliery buildings, and for pit sinking. The tidal range is 5 feet, but at low tide there is a depth of 5 fathoms of water at the base of the cliffs. The largest vessels afloat can, at any time, and in any weather, go alongside the pit's mouth for coal. The site is within view of the Sydney Town-hall clock, and the coaling of the principal lines of ships."

As to the cost which so excited the derision of my unbelieving friend, the Professor says :—

"I have based my estimate of the cost of erecting a colliery on the company obtaining a free site in the Military Reserve, on the Australian Wage Rate of 1893, and on thoroughly experienced engineering. I have omitted all outlay on retaining walls and coal bunkers, and all company expenses during development. On this basis, I estimate an up-to-date 2,000 ton per shift plant should not cost more than £180,000."

I might say that, to my own personal knowledge, estimates from other experienced engineers are in the hands of the engineer to the company, from which it is perfectly certain that tenders will be forthcoming to do all the work necessary to put the pits in full working order within a period of three years for a sum not in excess of Professor Benton's estimate.

As to labour, he thus reports :—

"There is abundant coal-mining labour in Australia, and the conditions of life in Sydney are specially attractive. I have seen nearly all the rocks

extracted from the bore-hole. Sinking, for the first 700 feet, will be in dry building sandstone, and below that depth entirely in shales and fine conglomerates. The sinking throughout will be dry, and in easy ground. The Bulli Seam is flat, dry, has a good roof and floor, and is extraordinarily cheap to work. With full time working, the cost for all labour and material, in placing coal free on board, should not exceed 4s. per ton."

As I am only concerned here in giving you the scientific and economic facts, I refrain from wearying you with further extracts from, admittedly, the very highest authorities; but, surely, I have said enough to satisfy any candid and unprejudiced mind that here we have made a discovery of natural wealth, calculated to enormously increase the riches and importance of the chief city of Australia, and with cheap fuel, so easy of access to ships, we may expect cheaper freights, and this opens out possibilities of increased trade, improved credit, and a more intimate connection with our own kith and kin at home, based on mutually beneficial and profitable commercial relations; quite sufficient to justify me in having thus prominently drawn your attention to this last startling proof of the unbounded resources of the fair colony, of whose citizenship I gratefully acknowledge myself a proud and privileged possessor.

I could still go on to tell you of the resources of this favoured land. Much could be said of its scenery, its natural wonders, its value as a health resort, the recent enrichment of the Great Western plains by the discovery of abounding supplies of artesian water. The splendid deposits of marble, slate, porphyry, granite, and other building materials, all susceptible of use in the most ornamental purposes of architecture. An interesting paper might be written descriptive of the social, artistic, and intellectual life of the people, their recreations, politics, and polemics, but I am fearful lest I have already exhausted your patience.

Suffice it to say that the prospective development of this the mother colony of Australia, bids fair to out-pace even the best periods of her past history. Her recuperative powers are as strong as her natural resources are magnificent, and with a temporary adversity have come those sharp lessons which are even now being manfully put to "sweet uses," while in all the higher and nobler elements of loyalty, integrity, honesty, and faith, the aspirations of the rising generation are, I think, in kindly responsive sympathy, with the sincere

good wishes of England's best men and women. The best natures on both sides the great waters that divide us, yet increasingly are uniting us, are striving to appreciate, understand, and love, each the other more heartily as time goes on. To this end, may your presence here this night, and these poor words of mine, be a contribution, hearty, though humble; and so, with loyal lips, and loving hearts, we may echo the toast, which is prayer, aspiration, and benediction in one, "For Queen and Empire; God bless and prosper both."

DISCUSSION.

Mr. GEDDES, as an Australian, expressed gratification at the excellent paper read by the able President of the Chamber of Commerce of Sydney, and said the question of frozen meat, and, in fact, the development of the produce trade generally of Australia, bore very materially on the future welfare of the British Empire, because there could be no doubt that though they associated the great prosperity achieved by Great Britain with the past glories of her history, at the same time much was directly attributable to the immense development of the commerce, and as a factor in this, the price of food in the manufacturing countries of the world, would materially influence their development in the future, and in the great competition for existence it would be advantageous if British labour was taught to believe that wages were not regulated by the price given by the employer, as by the cost of production in other parts of the world. To be a great manufacturing nation one had, to some extent, to sacrifice agriculture. At the present time agriculture had been sacrificed in England to the great benefit of the manufacturers, and the time would come when even the cost of living would tend to turn the tide of the huge stream of exports from Australia, or the imports from England into that country. Until very recently England had had practically the monopoly of the whole trade of the colonies, but to instance one example, viz., wool, he might state that the restlessness of the nations of the world, and the jealousy they felt towards the commercial supremacy of England, was being materially and practically felt. And, although in 1880 wool was concentrated in London, to be distributed from thence throughout the world, last year 100,000 bales were sent direct from Australia to the Continent, to the great loss of English warehouses and English labour. This was a material question, and as this great competition for commerce pervaded the whole world, the question of cheap food supply would come into far greater prominence. In asking them to take products from the colonies, they did not wish to be thought extremely selfish,

but they must take into consideration that the colonies had taken millions of pounds worth of the manufactures of Great Britain, and though they sent their wool here they took a great deal more in exchange. There would be a time shortly when France, Germany, Italy, Russia, Italy, and other nations would compete with England in the colonies; and although Australians would shed their last drop of blood, if necessary, for the benefit of old England, they would by no means spend their last shilling. There was no sentiment in commerce. They were as eager at the present time to foster the markets of the Continent as well as those of England, and they really required a little encouragement. Their meats—sound, cheap, and wholesome—were being taken by the French and German armies, and it was to be hoped they would be taken also by the armies of the British Empire.

The CHAIRMAN said he was glad to hear this valuable paper, and though the month of May presented a great many counter attractions, yet the appreciative audience present proved the interest such papers excited.

Mr. S. HERBERT COX said he was glad to have the opportunity of speaking on the mines of Australia, and particularly New South Wales. He must say he thought Mr. Inglis had rather left the gold and tin mining industry out in the cold, and while speaking of the coal so enthusiastically, and quite justifiably, he hardly alluded to the great influence that gold mining had had on the colony. It was true that New South Wales was less indebted to gold-mining at the early stage than any of the colonies, but still it owed a great deal to the large production of gold, and he thought, in future, there was a very great deal to be done in gold mining there. You might go from north to south, from the Victorian to the Queensland border, and throughout the whole width of the coastal ranges to the central inland plain, you could hardly go 20 miles in any direction without coming to gold. It might not be worked as payable mining at present, and it might be some years before it would be, but that payable mines did exist almost all over New South Wales was practically demonstrated. There were miners working on small reefs in all sorts of places, which paid them very well for a certain depth, but after sinking to that depth, perhaps finding the stuff rather poor just at the time, they searched elsewhere for reefs which had a more tempting appearance. But after a district had been abandoned practically, such as the district of Hill End, which had yielded some enormous returns of gold, and had lain for years and years, with only an odd prospector about, fresh discoveries were again made, and at Hill End, at the present moment, there were some very good mines being opened up. Again, taking the district of Temora, and just about there, they saw by the telegrams there was an important deposit discovered in Wyalong, which was not looked upon

as a mining district until the other day. There were hundreds and thousands of mines which would be opened up in the future, and would pay very well. Again, they heard a good deal of the working of the banket in South Africa at present, and of large bodies of comparatively low grade stone which were being worked, but New South Wales was not quite out in the cold even on a question like that. There were the big deposits of Belubula, in which crushings had run to over $\frac{1}{2}$ oz. to the ton, with millions of tons of stone in sight. Then there were workings in slate at a place south of Sydney, the name of which he forgot, where he had seen one quarry 100 ft. by 80 by 60, and the whole of that was taken out and crushed. There was no quartz to be seen, but only slate with very fine leaders, perhaps the thickness of a knife, but the return of the crushing was 17 dwts. per ton. All that quantity had been worked through with quite a small battery. Silver mining was comparatively a new industry. It had been talked about so much lately that he did not think he could add much concerning it. There was, however, a point about tin which, perhaps, was of some interest. The tin mining in the colony had been, up to the present time, almost all alluvial. This alluvial tin must necessarily have come from lodes of some sort, and there was, therefore, no doubt a great future for tin mining. But even the question of alluvial tin was not finished. Up in the Vegetable Creek district, where the largest amount had been obtained, there were still great tracts covered with basalt, under which the old river beds undoubtedly continued, and there must be a very large quantity of this oxide of tin to be taken out in future. With regard to the minor minerals and gems, he thought, perhaps, Mr. Inglis had attached too much importance to the gem industry. He looked at it from a hopeful point of view, but although he knew there were a large number of diamonds found, in fact, in one case 242 carats washed out of six loads of stuff, and that within a very few feet of the surface, still these diamonds were nearly all small as far as he was aware. He only knew of one instance of a diamond of five carats, and very few over one, and the great majority were about $\frac{1}{4}$ carat. He was not aware of any other gems of a saleable quality found in the colony.

Mr. LETT said there were the opals.

Mr. COX said those had been discovered since he left the colony, and he had forgotten them for the moment. As far as sapphires, zircons, and stones of that sort were concerned, he did not think much of value had been found up to the present time. He might emphasise one point in connection with the coal. The difficulty of determining the exact depth of the coal was rather enhanced by the fact that the beds all round Sydney were lying unconformably on the coal measures, and there was very considerable difficulty in determining what the exact thickness of those sandstones was at this point.

There was no doubt a great deal of information obtained by two or three bore-holes with shafts which were put down, but for the members of the Geological Survey to have come so close as 30 feet of the depth was one of the finest proofs of the capacity of the gentlemen carrying on the survey which could possibly be given.

The CHAIRMAN reminded Mr. Cox that Mr. Inglis stated in his paper that "the gold industry was now entirely on a fresh revival." He did not leave it out entirely, but probably was of opinion that gold was quite able to take care of itself. Mr. Lett had referred to the opals, and perhaps he would be able to give them some information about them. A short time ago some magnificent specimens were sent over, and though he was rather familiar with Ceylon opals, these far surpassed in beauty and colour any he had ever seen. The only ones at all comparable to them were some said to come from Arizona, but he had reason to believe that those originally came from New South Wales.

Mr. C. U. W. LETT said he regretted he could not give much information about the opals, as it was a new discovery since he left the colony, and all he knew was from reading. However, at the Imperial Institute, they had a magnificent collection, worth about £1,200, lent by a gentleman in Hatton-garden. There were large deposits in the neighbourhood of Wilcannia. It was said there was a prejudice against opals in England, and not much demand, but there in America there was a great sale for them. Unfortunately, America was sharing the prevailing depression, and, consequently, the industry was at a low ebb, but he hoped in future there would be a very large return from these mines.

Mr. INGLIS, in reply, said he must ask Mr. Cox to remember that he could not possibly go into detail as to all the different industries, and, as he took three typical industries from the pastoral and agricultural, he thought he would be best consulting the convenience of the meeting in not wearying them by painting the lily or gilding refined gold. He knew the gold industry of Australia was generally recognised, so that he preferred to refer to other things, and, therefore, dealt more with pigments, gems, and coal, which were seldom spoken of. The recent discovery of gold might be taken as a typical illustration of what might be expected in every department of industry when once the enormous resources of that great continent began to be developed. He had always been an advocate for opening all the land to miners under proper restrictions. There was a vast estate called the Church and School Lands, consisting of many thousands of acres, some of which was very highly charged with mineral deposits, and when he was Minister of Public Instruction he brought in a measure, and passed it through the House, by which they were able to give

permits to search for minerals on this vast estate, which up to then had been quite closed against the mining industry. So that really he was himself a pioneer in unlocking a large part of the country to the operations of the working miner, under a system of regulation and control which had been found to work very satisfactorily. That paved the way to a demand for a fuller recognition of the mining industry by giving, under proper conservation of the surface rights, access to the great locked-up freehold land of the colony to the hands of the working miner. On the passing of this measure, a large amount of land, hitherto locked up against mining operations, would be found to be very productive in this respect. It was very gratifying to him to have had three old Australians—Mr. Lett, Mr. Cox, and Mr. Geddes—substantiating what he had said. He was not at all given to exaggeration, and had had so many ups and downs that he was not so sanguine as he used to be, but he could thoroughly substantiate every word he had said. People in England had no idea of the enormous wealth of those regions, which it was the custom, not so many years ago, to hold rather lightly. He was thankful to say the Little England School had had an effectual extinguisher put upon it, and all schools of thought were now as anxious as the colonists themselves to maintain an intimate connection between them and the great Mother Country. He had purposely put his address in a popular form, and hoped it would lead some who read it to take a deeper interest in Australia.

The CHAIRMAN then proposed a cordial vote of thanks to Mr. Inglis for his very able paper, which was carried unanimously.

MEETINGS FOR THE ENSUING WEEK.

- MONDAY, JUNE 18...Geographical, University of London, Burlington-gardens, W., 8½ p.m.
- TUESDAY, JUNE 19...Statistical, Geological Museum, Jermyn-street, S.W., 7¼ p.m.
- Zoological, 3, Hanover-square, W., 8½ p.m.
- Colonial Institute, Whitehall-rooms, Whitehall-place, S.W., 8 p.m.
- WEDNESDAY, JUNE 20...Meteorological, 25, Great George-street, S.W., 7 p.m.
- Geological, Burlington-house, W., 8 p.m.
- Microscopical, 20, Hanover-square, W., 8 p.m.
- THURSDAY, JUNE 21...Royal, Burlington-house, W., 4½ p.m.
- Antiquaries, Burlington-house, W., 8½ p.m.
- Linnean, Burlington-house, W., 8 p.m.
- Chemical, Burlington-house, W., 8 p.m.
- Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m.
- Historical, 20, Hanover-square, W., 8½ p.m.
- Numismatic, 22, Albemarle-street, W., 7 p.m.
- FRIDAY, JUNE 22...SOCIETY OF ARTS, 8 p.m. Conversation at the Imperial Institute, South Kensington.
- Physical, Science Schools, South Kensington, S.W., 5 p.m.
- SATURDAY, JUNE 23...Botanic, Inner-circle, Regent's-park, N.W., 3¼ p.m.

Journal of the Society of Arts.

No. 2,170. VOL. XLII.

FRIDAY, JUNE 22, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

FINANCIAL STATEMENT.

The following statement is published in this week's *Journal*, in accordance with Sec. 40 of the Society's Bye-laws :—

TREASURERS' STATEMENT OF RECEIPTS AND EXPENDITURE FOR THE
YEAR ENDING MAY 31ST, 1894.

[illegible]

Cr.		£	s.	d.	£	s.	d.
By House :—							
Rent, Rates, and Taxes.....		388	7	0			
Insurance, Gas, Coal, House expenses, and charges inci- dental to meetings.....		227	2	2			
Repairs and Alterations.....		82	3	4			
		<hr/>			697	12	6
„ Office:—							
Salaries and Wages.....		2,218	11	4			
Stationery, Office Printing, and Lithography		290	19	10			
Advertising		91	14	6			
Postage Stamps, Messengers' Fares, and Parcels		216	13	9			
		<hr/>			2,817	19	5
„ Library, Bookbinding, &c.					79	12	0
„ Conversazione (1893).....					639	16	0
„ <i>Journal</i> , including Printing and Publishing..					2,142	4	3
„ Advertisements (Agents and Printing)					518	17	1
„ Examinations					714	4	9
„ Medals:—							
Albert		43	13	6			
Society's		32	5	0			
		<hr/>			75	18	6
„ Swiney Prize.....					200	0	0
„ Drawing Society Prizes					11	2	0
„ Owen Jones Prizes.....					22	1	0
„ Mulready Prize					20	0	0
„ John Stock Prize					20	0	0
„ Cantor Lectures					227	1	4
„ Howard Lectures					11	3	3
„ Juvenile Lectures					22	0	0
„ Sections :—							
Applied Art.....		61	4	0			
Foreign and Colonial		61	4	0			
Indian		74	11	3			
		<hr/>			196	19	3
„ Committees (General Expenses)					11	15	2
„ Investment of Life Compositions in Consols..					378	0	0
		<hr/>			8,806	6	6
„ Cash in hands of Messrs. Coutts and Co., May 31st, 1894					917	19	11
Do. in hands of Secretary ...		23	15	9			
		<hr/>			941	15	8
		<hr/>			£9,748	2	2

LIABILITIES.

	£	s.	d.	£	s.	d.
To Accounts due	290	1	4			
„ Examiners' Fees	308	6	0			
„ Examination Prizes and Medals	65	0	0			
„ Sections:—Applied Art, Foreign and Colonial, and Indian	190	0	0			
„ Accumulation under Trusts	325	6	9			
Excess of Assets over Liabilities				1,187	14	1
				10,622	11	1
				£20,810	5	2

ASSETS.

	£	s.	d.	£	s.	d.
By Society's Funds invested in—						
£11,542 12s. 0d. Consols, estimated at	11,500	0	0			
£500 Canada 4 per Cent. Stock, estimated at	525	0	0			
£500 South Australia 4 per Cent. Stock, estimated at	500	0	0			
£530 10s. 1d. New South Wales 3½ per cent. Stock, estimated at	500	0	0			
£500 New South Wales 4 per Cent. Stock, estimated at	515	0	0			
£217 Great Indian Peninsula Railway 4 per Cent. Debenture Stock, estimated at	270	0	0			
£1,500 Queensland 4 per Cent. Bonds, estimated at	1,500	0	0			
£500 Natal 4 per Cent. Stock, estimated at	525	0	0			
Ground Rents	526	0	0			
				16,361	0	0
„ Subscriptions of the year uncollected	552	6	0			
„ Arrears, estimated as recoverable	180	0	0			
				732	6	0
„ Property of the Society (Books, Pictures, &c.)	1,800	0	0			
„ Advertisements on the Books, due, and in course of execution*	675	3	6			
„ Cash in hands of Messrs. Coutts and Co., 31st May, 1894	917	19	11			
„ Do. on Deposit (interest on Trusts)	300	0	0			
„ Do. in hands of Secretary	23	15	9			
				£20,810	5	2

* A portion of this sum is subject to charges for printing.

INVESTMENTS, &C., STANDING IN THE NAME OF THE SOCIETY.

Ground Rents	£7,690	0	0
Consols	13,146	12	3
Metropolitan Railway 4 per Cent. Perpetual Preference Stock	500	0	0
Bombay and Baroda Railway 5 per Cent. Guaranteed Stock	2,450	0	0
Canada 4 per Cent. Stock	923	0	0
South Australia 4 per Cent. Stock	605	16	0
New South Wales 3½ per Cent. Stock	530	10	1
New South Wales 4 per Cent. Stock	500	0	0
Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock	2,170	0	0
Queensland 4 per Cent. Bonds	1,500	0	0
Natal 4 per Cent. Stock	500	0	0
Cash on Deposit with Messrs. Coutts and Co.	300	0	0

TRUST FUNDS INCLUDED IN THE ABOVE.

1. Dr. Swiney's Bequest	£4,500	0	0	Invested in Ground-rents, and chargeable with a sum of £200 once in five years.
2. John Stock Trust	100	0	0	Consols, chargeable with the Award of Medal.
3. Benjamin Shaw Trust for Industrial Hygiene Prize	133	6	8	„ „ „ Interest as a Money Prize.
4. North London Exhibition Trust	102	2	1	„ „ „
5. Fothergill Trust	388	1	4	„ chargeable with the Award of a Medal.
6. J. Murray, in aid of a Building Fund	54	18	0	„
7. Subscription to an Endowment Fund	502	2	2	„
8. Dr. Aldred's Bequest	173	10	0	„ chargeable with the Award of a Prize.
9. Thomas Howard's Bequest	500	0	0	Metropolitan Railway 4 per Cent. Perpetual Preference Stock, chargeable with the Award of a Prize for an Essay.
10. Dr. Cantor's Bequest	4,600	0	0	Bombay and Baroda Railway Stock, and Ground-rents. Interest applied to the Cantor Lectures.
11. Owen Jones's Memorial Trust	423	0	0	Canada 4 per cent. Stock, charged with the award of Prizes to Art Students.
12. Mulready Trust	105	16	0	South Australia 4 per Cent. Stock, the Interest to be applied to keeping Monument in repair and occasional Prizes to Art Students.
13. Alfred Davis's Bequest	1,053	0	0	Great Indian Peninsula Railway 4 per cent. Guaranteed Debenture Stock. Interest at the disposal of the Council for promoting the objects of the Society.
14. Accumulated Interest on Trust Funds	300	0	0	On Deposit with Messrs. Coutts and Co.

The Assets, represented by Stock at the Bank of England, and Securities, Cash on Deposit, and Cash balance in hands of Messrs. Coutts and Co., as above set forth, have been duly verified.

B. FRANCIS COBB, }
W. ANDERSON, } *Treasurers.*

J. O. CHADWICK & SON, *Auditors.*

HENRY TRUEMAN WOOD, *Secretary.*

Society's House, Adelphi, 19th June, 1894.

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One Hundred and Fortieth Annual General Meeting, for the purpose of receiving the Council's Report and the Treasurers' statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new members, will be held, in accordance with the Bye-laws, on Wednesday, 27th June, at 4 p.m.

(By order of the Council),

HENRY TRUEMAN WOOD,
Secretary.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday, May 22, 1894: Sir HENRY DOULTON in the chair.

The paper read was—

DECORATIVE ART AND ELEMENTARY EDUCATION.

By SELWYN IMAGE, M.A.

It is profitable, as well as pleasant, to look round us from time to time, and see what there is upon which we may congratulate ourselves, with reason and heartiness. The pessimist, for ever picking us to pieces and foretelling our discomfiture; the optimist, who would catch our favour by laudation of all our methods and accomplishments, assuring us we are the most wonderful generation of men that ever drew breath: these are both dangerous acquaintances, dangerous counselors. I do not say, let us turn a deaf ear to either of them, but let us lend them only a discriminating ear. It is certain we have many faults and many follies; but, I venture to think, it is not less certain that of some virtues and of some advancements we can also give proof; and the thing is, as the Greeks used to say, "to know ourselves"—to bring ourselves persistently to the bar of our own intelligence, giving due weight, no doubt, to the consideration of both external praise and external criticism, but absolutely submitting ourselves neither to the one nor to the other. Well, the matter which has brought us together this evening is just one of those, I will make bold to say, upon which we may congratulate ourselves fairly, upon which, as a matter of

fact, congratulate ourselves we all do. It would be impertinent of me, impertinent both in the literal and popular sense of that word, to spend time before such an audience as this in arguing on behalf of elementary education; upon our wisdom in insisting on it, or upon its benefits to the community. In this matter, at all events, the State has spoken its mind plainly, and enforced its will. Our children, *volentes nolentes*, are to receive the elements of education; and this high-handed compulsion, on the whole, has our approbation. We grumble, no doubt, at the rates; we are not altogether sure that our educational authorities are, in all their regulations, wise; we think them too experimental, or too extravagant, or too notional; and we speak our minds on occasion, sometimes, it may be, a little petulantly: but on the general proposition that education there must be, and that our children, without exception, shall be made to undergo the discipline of it—upon this we are at one. I need not take into consideration the abnormal personages one comes across here and there, who assert their dissent from this unanimity, who make a mock at us and say, "What fools you are for your pains! How much better let the children play about, instead of turning them into prigs! Reading and writing only add to life's burdens and confusion." My own experience is that such personages either are not serious, or else that they are diseased, taking up, as is the curse with so many of us in so many matters at this end of the century, a pose.

Between unanimous assent, however, to a general proposition and a unanimous, intelligent, wise understanding of what it involves, there is a wide space: for men often have an instinct that such or such a thing is right, and give in their adherence, at least their tacit adherence, to it; but then they have not the wits, or the experience, or they will not be at the trouble, to see its far-reaching significance, so that they do not actively further it with that sympathy and intelligence, that care and self-sacrifice, which are necessary to its sound establishment and fruitful result. In connection with the matter before us, I think, this reflection is in point. We assent to the necessity of elementary education, a compulsory education for children at large: it is a great thing that we do assent to it, but our assent does not finish off our obligation. What is to be the aim of this education, the scope and method of it? What

relative importance will sound reason lead us to attach to it? What sacrifices of time, or money, or self-interest of any kind, will the wise man and good citizen feel himself bound to make, or to be ready to make, in its behalf? You may be inclined to reply that it is surely vexatious, unpractical, to urge upon the public that they should study the educational question at all intimately, for that the immense mass of them are in the nature of the case incapable of such a study, having neither the time nor the experience necessary for conducting it with profitable result. You may say, "We do all that can be expected of us, when we choose, and delegate certain of our number to undertake this particular branch of the State service; our interference, our suggestions, any insistence on our part that things should go this way or should go that, could only embarrass these public officials, and make the matter in hand more confused."

Perhaps, in this obvious, and I will by no means venture to call it altogether unnatural, justification on our part of the principle of non-intervention, we are allowing ourselves to be a little beclouded and led astray by that convenient term "the public;" and then, in the second place, I cannot help feeling that we scarcely take enough account of the fact how, after all, this State-enforced education of ours is comparatively but a thing of yesterday, experimental, therefore, of necessity and to a large degree: an immense State experiment indeed, one might call it, destined to be begun and, for a while, carried on amid conditions of thought and of social reorganisation (ah! what ferment, confusion lurk there inevitably!) almost wholly new, and in their results incalculable. The most shrewd, thoughtful, enthusiastic amongst us, therefore, who feel the importance of this great novel movement, and give themselves to its development, even these are in some measure but seeking out the path, their hands spread often enough in the dark as they *feel* their way, with no fine, ancient, assured tradition upon which they can fall back. Yes, as pioneers we may think of them in a new country, sometimes hitting on a track, which promises well and leads nowhere, or actually leads to disaster, the adventurer compelled by-and-bye to retrace his steps, if good fortune permit it, and at best to begin, as the children say, all over again. It is, indeed, by some such analogous ideas as these, that we bring home to ourselves the position, the difficulties of our elementary educational authorities to-

day; and I will make bold to assert that the best of them, not those who are pertly assured of themselves and of everything (and, no doubt, there are such), but those, whose natural gifts, training, experience, and devotion befit them for their keenly-appreciated responsibilities, will not repudiate my similes as uncomplimentary or unjust. On the contrary, it is precisely these men who are conscious of their isolation, and in some sense of their incompetency, and who would so very heartily welcome, while actually they do deplore the lack of, an intelligent and sympathetic public interest in the matter of elementary education; yes, who would be so glad to feel that there was at their back, so to say, a council of thoughtful and unprejudiced men and women, up and down the country, turning the whole question over in their minds, and debating it with one another; threshing it out, as the expressive saying is, intent on catching its significance, and prepared to give effect to their well-considered conclusions. Such an intelligent and energetic public opinion as this is what we want for the wise guidance and development of our elementary education, is what the best men in actual authority over it complain that they cannot arouse. The public—oh! assuredly—that is a very comprehensive term, comprehensive of an immense, incalculable, mass of human beings, too ignorant, too prejudiced, too overburdened, too selfish, too miserable, to make one wish, perhaps, anything else from them in this affair, than that they should hold their tongues and suffer the work to go on; but comprehensive, surely, too, of a large, even if of a far less large, body of open-minded and reasonable men and women, whose interest and thought, once steadily brought to bear upon the subject, might do—ah! how much for it. Now, what practically seems to be the state of the case? Did any of you, ladies and gentlemen, chance to observe a note published in the *Pall Mall Gazette*, a few days ago, giving an analysis of the voting at past School Board elections here in London? I give you these figures from the *Pall Mall Gazette*, in its issue for Friday, the 4th of May, this current month; and though, of course, I cannot vouch for them, I take them the more readily on trust, because the state of things which they reveal is just the sort of state my own experience would lead me to imagine. In Lambeth, then, at the last election, out of 62,000 voters on the register, only 13,000 recorded their votes; in Chelsea,

out of 77,000 voters, 19,000 polled; in Hackney, out of 68,800, 14,800 polled; in Finsbury, out of 86,800, only 16,000. To quote the comment of the writer in the *Pall Mall Gazette* :—"The education of nearly half a million of children at a cost of close on £2,000,000 a year, is a matter which 75 per cent. of the electors regard with absolute indifference, not even taking the trouble to go to the poll. At Parliamentary elections about 70 or 80 per cent. of the registered votes are polled; but at the last London School Board elections only in a few divisions did 25 per cent. of the electors vote." There, then, is a plain statement of the case, and a statement which I am afraid there can be no doubt is substantially correct. Yes, quite so; but what are we to conclude from it? Are we to conclude from it that only 25 per cent. of the voters of London, this rich and enlightened centre of civilisation, consider the elementary education of our children an affair of importance? or that 75 per cent. of them are opposed to such education, but having had the thing somehow or another forced over their heads, determine, like Achilles in his tent, to stop at home and sulk? or, again, that 25 per cent. of them is veritably all who are capable, or who think themselves capable, of taking an intelligent interest in the problem of education, the rest modestly holding their tongues, not even so much as lifting a finger? Why, we know, of course, that such conclusions as these would be ludicrous conclusions. As I said to start with, the Public Elementary Education Act as the enunciation of a general principle has practically our unanimous assent; but between unanimous assent to a general principle and a unanimous, intelligent, wise understanding of what it involves, between adherence to a principle and active interest in trying to comprehend and forward it, there is a wide space. Precisely, and in this matter of elementary education—a thing, indeed, of which a wise man, himself an authority on education and other important matters of state, Sir Henry Wotton, once said, "Both writers and rulers well know what a stream and influence it hath into government; so great, indeed, and so diffusive, that albeit good laws have been reputed always the nerves or ligaments of human society, yet are they (be it spoken with the peace of those grave professors) no way comparable in their effects to the rules of good nurture,"—it is in this matter of elementary education, I say, that what we need is to try and bridge over, or lessen, at all events, this wide space. We

want intelligent men and women to arouse themselves; to set that intelligence of theirs at work; to try and make for the formation of an intelligent public opinion, free, widely-reaching, sensitive; if that is not so, I cannot tell what in the world we are met here for this evening. We are not legislators, or even members of the London School Board. Probably, but few of us are engaged in educational work, or have any immediate power in this or that school of trying this or that experiment; our duties and talents, it is likely, for the most part, lead us along quite different lines; and yet I will not believe that we are wasting our time, wandering fatuously into a discussion of matters that can have no effectiveness, if we spend a few minutes in quietly thinking over (yes, even somewhat in the abstract, it may be, as an exercise more than anything else, after all, perhaps, in the consideration of what a State might conceivably take to be its ideal in the matter), the place which the decorative arts claim from us in the elementary education of our children.

There is what lies before us—the place of the decorative arts in elementary education. But, before going further, it is well that we should clearly understand the terms of our subject, and the limitations they lay upon us. Half the ineffectiveness of dissertations such as this, and of any discussions which follow them—as, indeed, half the ineffectiveness and annoyance of a great deal more than half of the questions and arguments upon them with which the world confuses itself, arise from our not being at the initial trouble of attaching an exact meaning to words; of not submitting ourselves to the discipline of rigorously confining our remarks to the narrowed matter in hand. To blame a man for not dealing with points, with which he had never any intention to deal; oneself to run up some little by-path, which, however seductive, after all is a by-path; to suffer some preconceived notion, possibly irrelevant, certainly unimportant, to so impose itself upon us that, as the saying is, by hook or by crook, we will at this point or at that force it in, and have our word upon it; all these are the temptations which, on such an occasion as the present, assail us, and to which, without caution and restraint, we succumb readily. As I am anxious—as I am sure you are anxious—as far as possible, not so to succumb, let me at once insist upon the two epithets in the title of this paper, *Elementary and Decorative*. We

are not talking about education in general, or about art in general; our subject is far more limited, we are concerning ourselves only with so much of education as we believe every child of every class in the community ought to be subjected to before he is allowed to do anything towards earning his livelihood, with just that first common equipment of him for life and its business: and we are concerning ourselves only with so much of art as has for its aim to make pleasant and interesting the surroundings of his life with the charm of line and colour, cunningly disposed. It is true, no doubt, that no piece of art actually is limited to this simple effect upon us, not art even which leaves alone the human figure, with its suggestive emotions, confining itself to conventional arrangements of line and mass; something beyond itself is borne in upon and stimulates the imagination—not least, that eager imagination of childhood, for ever inventing a world of its own—by the merest pattern, for instance. Yet, the decorative arts have this for their distinction, that they aim consciously at nothing else than gladdening our eyes with line, colour, dispositions of tone; with the charm of sensuous beauty lying in these things, appreciated consciously, unconsciously, and having no end save themselves, no ulterior motive at all lurking in them to catch us unawares for edification in some other sphere altogether.

It would be surely pedantic this evening to trouble you with any attempted definition of education. I assume, however, that none of us here dream that we have done our duty by a child, when we have taught him that twelve times twelve is one hundred and forty-four, or that the earth is a spherical body revolving on its own axis round the sun, or that William the Conqueror landed in England in the year 1066, or that a perfect sentence must be at least composed of subject, copula, and predicate. With bare facts such as these, indeed, we have to instil into him a sure acquaintance, sparing in the process neither on our part, nor on his, the drudgery so often inevitable. I remember, when I was myself a child, it was the fancy amongst some good-natured persons to dream it possible that this drudgery might, for the pupil at all events, be cunningly evaded, the salutary knowledge, like salutary medicine conveyed unsuspectingly in a spoonful of jam, being made as little distasteful in process of assimilation by him as a game at peg-top or a visit to the panorama. That in the old days the bitterness of knowledge in

its acquisition was somewhat unnecessarily, cruelly, unmitigated, the thing driven into us barbarously at the point of the ferrule; ah! yes, amid what tears and heart-breaking, is undeniable. But, for myself, I confess to a radical suspicion of too much softness in the matter. Discipline, after all (the experience of every day and every effort, brings it home to us), has disinclination, trouble—yes, positive pain—for its attendants. The value, the indispensibility of discipline lie, indeed, precisely here; that it trains us amid this disinclination, trouble, and pain, to voluntarily accept them, rest masters of ourselves, and compel the very vexations which so annoy us to minister to our development. In every branch of knowledge “the beggarly elements,” the isolated, barren facts, the rules of thumb, the use of this or that instrument necessary to produce some given result, are to be had only at the price of much that imposes itself on us with extreme unpleasantness. For the child, too, as well as for the man, the child appealing to some of us very movingly with his natural love of freedom and gaiety, his pathetic tenderness, his suggestions of, and companionship with, all that is bright, happy, at large in the world of nature; still, even for him, it must not, assuredly it ought not to, be all down and sweetmeats.

But then, this instruction in facts, though popularly passing with us as if, indeed, adequately synonymous with education, and rightly insisted upon with whatever necessarily attendant shall we say, austerity? is but a department of education after all, and a department not of the highest importance. It is an old tale, the man stuffed with knowledge may be a fool and a clown still, uneducated for all his examination successes and certificates, and his pert alertness. Character, manners, breeding, taste, these are some of the words which occur to us, as we think of that large province of education lying beyond; things not indeed immediately communicable to the child, as the multiplication table or physical geography, for instance, nor his advancement in them able to be brought to the test of an examination paper; yet things communicable assuredly in some sense, springing into life and developing under example and the influence of surroundings; the child taking a certain complexion from those examples, surroundings, as unconsciously, but as veritably, as when he returns from his holiday, he has taken the impress of the sun and the salt breezes, and you see it there on his cheeks.

Education, then, not only intellectual, but ethical and æsthetic (for our purpose this evening it is the child's æsthetic education we are solely concerned with) the State must properly regard as part of the obligation it has undertaken in stepping as it has *in locum parentis*. Nor do I think that the State shows evidence of being unaware of this, or of seeking to ignore or minimise its obligation. If we look at the Board schools erected here in London, there are some not insignificant signs about them, we may surely say, that in their erection and appointments there has been present some thought of beauty as well as of convenience and health. And the Board, as doubtless you are well aware, encourages its teachers to ornament their class-rooms, and has drawn up a body of instructions to assist them in the matter, keeping actually an eye upon the thing as of importance, with a collection of pictures and other objects of decoration there at its offices on the Embankment, upon which the various schools are solicited to draw. Yet undoubtedly it would be idle to pretend, indeed, it would be unreasonable to expect, that in our public elementary education the claims of the æsthetic side of education, its importance, its widely-reaching significance, are as yet, I do not say satisfied, but in any adequate degree recognised. The burden still lies somewhat oppressively on the authorities of fancying that immediate instruction, intellectual edification, must everywhere, and at all moments, be to the front; the ultimate justification, as it were, of every piece of ornament they sanction lying at hand in this, that it can readily be used for some practical lesson to illustrate and emphasise a fact in history or nature, or some useful method of work. A picture, let us say, or a piece of hanging stuff, I doubt whether they will yet quite frankly welcome and stand by for no other reason in the world than that it is an ornamental thing there on the wall, giving an added pleasure to one's being in the room; and if in the picture or the hanging there occur something—well, something purely decorative, fanciful—a bird or a flower, for example, whose precise counterpart is not in nature, which you assuredly would be hard put to it to name and give the habitat of out of any botanical or ornithological handbook, they are a little fluttered, I know. "We shall be giving the children false ideas," they tell you, "teaching them what is not the fact, undermining their sense of truth." I am not drawing on my imagination, sir, but recalling experiences of my own.

You see our educational system, our educational ideas, have not been so very long fledged. The obligation of instructing children in bare facts is still paramount with us, and looms upon us out of all proportion. Everything else but that seems so irrelevant; ah! so misleading, dangerous. The State, too, with the best intentions in the world, cannot be largely in advance of popular opinion and notions; it is, after all, the reflection and expression of these; and if the claims of this æsthetic side of education are to be acknowledged and satisfied in our elementary schools, there must first be current in the public mind, amongst a considerable body of intelligent persons seriously interested in the matter, a recognition of, a strenuous insistence on them.

And it is worth while, amid whatever present discouragements, however much in the air may at the moment seem to be any practical, widely-accepted recognition of this sort, to try and bring it about, to try and arouse and educate this public opinion, which can, at last, alone determine the matter.

In their connection with elementary education, it is possible, of course, to think of the decorative arts from two different points of view: we may think of them, that is, as providing definite subjects of instruction, or we may think of them apart from instruction altogether, as providing us in our schools with various kinds of ornament, to make things pleasant there for the children, and unconsciously to form their tastes. Let me call your attention to the fact that it is with the decorative arts, regarded from this latter point of view, that I am mainly concerning myself. Certainly, it is not concerning oneself with a mere personal whim, I think. Deep in our common human nature lies the æsthetic sense, the love of ornament, the determination, in some sort or another, to have it. The universal delight of childhood in coloured toys and picture-books, its scrawlings and daubs of paint over this or that object coming in its way, are, indeed, but indications and expressions of this ineradicable sense and determination; nor, as the children grow up, does the thing leave them. Pass along our thoroughfares, and look at the shops: what a profusion of ornament on all sides, upon everything—bad ornament, much of it, no doubt—put there, in no small measure, to conceal and palm off bad workmanship; but useless, surely, even for that detestable purpose, unless men and women of all ages and conditions cared for ornament, felt life

pleasanter for it, would have the thing. As one turns from the present to the past, the same experience confronts us. In the most remote villages, away from any centre of conscious art, the simplest of our forefathers must needs decorate their cottages, their utensils, everything they required for their surroundings and use in everyday life. I do but recall these facts to you in passing; they demand no illustration or proof, they are patent, indisputable.

The decorative arts, then, are, it would seem, not a sort of luxurious, fantastic addition to life, but a necessity of it; something we really cannot bear ourselves without, when once, at all events, there is shelter and food enough to keep body and soul together. At various times, however, these arts are more or are less excellent; and, seeing how fundamental and important is their existence, it is not a matter of indifference whether they are flourishing or are in a bad way. Now, the best authorities (I had almost said every serious authority) tell us, and I must confess I heartily agree with them, that at our own present time they are in a bad way. Nor can I console myself by reflecting that this adverse judgment upon us is merely the result of a well-known, common tendency to run down the present and belaud the past; or by recognising the undoubted existence in our midst of a number of individual artists, who give us decoration which need shrink from no comparison with the decoration of any bygone age. At moments of singular depression we are sometimes tempted to exclaim that decorative art is dying, is dead. No, that is not the case; I do not think in the nature of things it ever can be the case; but, unquestionably, the thing is in a bad way. That an individual artist here, and an individual artist there, can still give us good decoration is little to the point. For the truth is that when decorative art flourishes, you find it, so to say, flourishing not as a rare hot-house blossom, but as a common plant in every man's garden. There is an universal instinct for it, a tradition in the blood, and while a multitude practises it, no one practises it badly. Think of the specimens of decoration that have come down to us from the past—if you will, from no further back than the beginning of this century—insignificant pottery-ware, or bits of needle-work or wood-carving, mere trifles, which no artist designed or executed, but common workpeople, who gave themselves no airs, and merely made things charming to please themselves. How that ordinary decoration of our forefathers puts to

shame our own ordinary decoration! We are sometimes told, "Ah! you are befooled by your fancy, and by that irresistible magician, Time. Our things, too, will look as interesting a hundred years hence." Well, sir, I will give you one experience out of many which makes me doubt it. There still lingers, in Staffordshire, the craft of a certain kind of very common crockeryware, painted or stamped by hand. It is plainly the lingering of a tradition there, not the outcome of any definite art teaching. It has none of the seductiveness of age about it, the charm which actual years, and the imaginations born of them, so undeniably throw around a thing; it is of the common prosaic to-day. But, I have no hesitation in saying that, from a purely decorative point of view, in no ordinary crockery or china shop can you get anything to set beside it.

I do not pause to inquire curiously what are the causes of this degeneration in the decorative arts, or to suggest more than one means we might possibly try to remedy things. The points I am offering to your consideration are, first, the universal importance of these arts; secondly, the fact that now they indeed are degenerate; and, thirdly, inasmuch as they are degenerate through a loss of taste, of instinct, rather than a loss of interest, whether, beginning carefully in our elementary schools, we could not do something there to restore this taste, not so much by any actual instruction in the arts, as by the unconscious influence of surroundings.

You will not suppose that I am so ignorant or so wilful as to undervalue the effect of definite school teaching in draughtsmanship and design, or to ignore the excellent work more or less being carried on in these matters in our elementary schools. Drawing is now-a-days, I understand—to a considerable extent, at all events—made a compulsory subject; made so wisely, I think, and with, indeed, remarkable results. But the main object of this drawing, the proper, perhaps the only possible object of it, under the circumstances, is a disciplinary rather than an æsthetic one; it is to make the eye accurate and the hand steady rather than to cultivate the taste. That some cultivation of the taste accompanies—necessarily accompanies, it may be—this physical discipline of the eye and hand, one readily enough grants; and, judging from what one knows of the exercises usually given in our schools, yet, thinking of all the mass of beautiful decoration which might still conceivably be utilised for

the purpose of these exercises, I sometimes feel that a wider æsthetic result, a more effectual operation upon taste, might surely be expected from them than they at present yield. Only, after all is said and done, your drawing-classes in elementary schools, however carefully, wisely, widely selected may be the exercises, cannot but remain, on the whole, a means of physical training rather than of æsthetic cultivation; so that at best I doubt whether we are reasonable in looking in that quarter for the result of any serious amelioration of popular taste. Taste after all, too, a fine decorative sense, is something which we unconsciously assimilate and develop, rather than have directly communicated to us by instruction; beauty is there around us, and we drink it in as we drink in the fine air, the sunshine; yes, and it tells upon us, as they do, very largely without our thinking about it. So far as the children in our elementary schools are concerned then, so far as their æsthetic education is recognised as part of our obligation to them, and we look to it as at least one means of improving the national taste, the main thing we have to do is to try and make their surroundings during school hours beautiful: not merely of interest, observe, but of fine interest; not merely an appeal to their innate love of decoration, but a sound appeal to it.

"And some believed the things which were spoken, and some believed not," pointedly comments a famous historian on the result of a certain famous discourse at Rome. The words ring in my ears now, and weigh upon me as I draw to a close. I cannot hope to have carried all of you, ladies and gentlemen, entirely along with me; but whether you agree with my view, or do not agree with it, alike you will naturally expect that, before I sit down, I should give you one or two suggestions of what I imagine practically might be done to carry out the end I have been all this while urging upon you.

Well, of course, there are in the first place our school buildings themselves, the classrooms, the assembly-halls. Immense pains are already taken with the erection of these, and, on the whole, with admirable results. Without venturing on any criticism, which, indeed, would be mainly but detailed criticism, of such of the more recent of these buildings as I have seen, I will only remark that the ideal class-room, to confine ourselves to a single point, will be most carefully considered, not merely from a utilitarian and hygienic

point of view, but not less from a purely artistic point of view, in its proportions; the size, shape, and relative disposition of its windows, the mouldings of its cornices and woodwork, the design of the furniture, the spacing and colour of its walls, all these things having as much thought bestowed on them as if we were building and furnishing a rich man's house; the whole thing in its simple kind determinedly made as much a work of art as that should be, without allowing ourselves to be led astray into any niggardliness of care or expense by our friend the practical man, for ever petulantly reminding us that the thing, after all, is only a room to teach children in.

Having finished this beautiful building, and now ready to enter upon it, we naturally set ourselves, by degrees, to add to its sense of pleasantness and interest by bits of decoration, fixed or movable, in form and colour. I can imagine, for instance, how much use we may make of inscriptions written in fine characters, and well disposed upon the walls, nothing in the world being easier or more ornamental than such writing as our forefathers used it, with their unerring instinct for calligraphy, from the stately motto running round a church or palace to that on a gravestone, a sign, a drinking-vessel. Then we bethink ourselves, of course, of pictures, hangings, actual specimens of, or casts from, fine decorative carving, only being extremely on our guard against using these so as to give the place the appearance of a museum; yes, choosing and arranging them, not so much for what they are in themselves, not at all with any ulterior motive of turning them into object-lessons, but altogether with reference to their effectiveness as decorative elements in the room, itself so beautiful, however simple, in its proportions and finish.

Let me lay some emphasis, on this point of decorative effectiveness, as distinct from the inherent interest of the objects. In a museum or gallery inherent interest is everything, decorative effectiveness nothing. Size, therefore, the relation of things in form, colour, position, to their surroundings, to the room we see them in, matter here comparatively but little: but they matter everything, if the end we have in view is, for entirely æsthetic considerations, to add to the general impressiveness of the place, to make it in its total effect more interesting and pleasant. Yes, and that, as it seems to me, is precisely what we must aim at in the decoration of a public school-room; we must aim at its decorative effect as

a whole, for it is just there that will lie its value in the æsthetic education of the children. I can recall school-rooms on the walls of which I have seen indeed many objects interesting and beautiful in themselves, if you came up to and examined them: but, to anyone sitting in the room, how ineffective! and, in their casual disposition over the wall space, not merely how ineffective, but how destructive of any dignity in the general appearance of the place! Strength and breadth of treatment, an actual largeness, too, in size, these are the conditions we must insist upon; and, further, a most careful arrangement of the objects which fulfil these conditions, when we have once got them.

I do not hide from myself, that any satisfactory accomplishment of the idea I am commending has two obvious difficulties in its way; it will involve a certain expenditure, and at the present moment there is some lack, no doubt, of that kind of decoration precisely suitable to our purpose. Well, on the question of expense, I would only remark that experience might prove it less, perhaps, than we anticipate, and that no public money can possibly be better used than in the advancement of a sound education. If we are suffering, however, from the pitiable disease of niggardliness, I would hold my tongue altogether, till there is some hope of our recovery. As regards the other matter, the kind of decoration we want I have no doubt whatever will be forthcoming, if we make it worth while, if we give unmistakeable signs that we are intent on having it. Are we intent on having it? This æsthetic element in the education of our children, in their elementary education, is it borne in upon us as an idea of any moment: or do we think it has no claims upon us save in the flighty brain of this and that irresponsible doctrinaire, who occasionally amuses or wearies us with his fancies?

DISCUSSION.

The CHAIRMAN said he was sure everyone had listened with pleasure to the interesting, instructive, and able paper of Mr. Image. He agreed with Mr. Image that the æsthetic and poetical side of human nature was not sufficiently attended to at school, and the importance and significance of it was not recognised. This was peculiarly a scientific age, and it was necessary to cultivate the imaginative and æsthetic side of nature. He believed that in many cases there was really over-pressure in schools, and what

one would welcome would be that those who could not tackle the serious subjects might take in some of the teaching which had been so well explained that evening. There was an inequality of power as well as of taste in children. If we could recognise this, and give a variety of occupations, no doubt it would do a great deal of good. He considered that they ought to try and cultivate in children the habit of observation by means of the many beautiful things surrounding them, from which they would unconsciously learn much that would tend to charm and beautify their daily life. One of the most important things that children could be taught was drawing. Mr. Image had spoken rather slightly of drawing, but whatever might be the merit or artistic taste of a child, that child would overcome a great deal of hard work if the elements of drawing were early imparted. The power to draw seemed to be most valuable in elementary schools. If a person could take out his pencil and book and illustrate his ideas by means of a few pencil marks, instead of by words, one became interested in such an exposition, and many instances of the great advantage of this power in after life had lately come before him. He agreed with the reader of the paper that the surroundings of the class-room should be such as had been described. Art had many mansions and a great many entrances, but there was a great deal of dictatorialism as to what was pure art. He should be sorry to be upon a committee which had to decide what really constituted pure art. It was desirable that good works of art should be seen by children, and it was also important that they should be taught the nature of the materials with which art had to do. While recently going through the Exhibition at the Skinners' Hall, in company with Mr. Sparkes, he was very much struck with some remark made by that gentleman as to workmen understanding the nature of the material with which they had to do. He was sorry that that exhibition was now closed, as it was one of the most interesting of the kind that had been held in London for many years. It was known that the City Guilds Institute and the School Board of London had formed centres for teaching carpentering and some of the useful arts, and out of some of those had come many interesting things which had been alluded to by Mr. Image. The principles which should be cultivated in the schools should be truthfulness, simplicity, and sincerity. In architecture decoration must grow out of construction. On buildings they occasionally saw ornamentation which had been put on to disguise the lack of knowledge of the workman. If the principles which he had just enumerated were taught, he thought it would be commencing at the right end. It was said that England was not an artistic nation, and Sir Frederic Leighton had spoken of the difficulty of creating a genuine taste and judgment on a question of art among people not naturally gifted in that way; but he (the Chairman) thought that statement required

some modification. But if it was really the fact, as stated, he thought they could not begin too early to cultivate this taste in educating the children. He did not suppose a man could go into a library and judge of books who had no education or training; and why should they suppose that people untutored in art could go into picture galleries and judge of pictures? If they began to train children early, they would do a great deal in this direction. He felt strongly with the reader of the paper that the cultivation of the æsthetic side of nature would give a great deal of pleasure.

Mr. T. R. ABLETT said he did not at first quite understand whether the reader of the paper was adverse to the School Board system or in favour of it, but towards the end he got more confident; and he (Mr. Ablett) hoped that the opinion of Mr. Image that Board schools and other elementary schools should be highly decorated might find favour with the democracy. With regard to the voting on School Board elections, the figures read out were somewhat appalling, but it must not be forgotten that those who voted were not quite the same body as those voting at Parliamentary elections. One way to enable the democracy to express their opinion on School Board matters would be to extend the hours of election. In the metropolitan area not ten miles from London-bridge, where villa residents and working classes were divided by a mile to a mile and a half, there was only one polling-station, and that was near the villa residents, so that a working man would have to walk about three miles in order to record his vote, which he was not able to do before the close of the poll. He felt sure that there were an immense number of working men who were interested in the education of their children, and who would be only too glad to have a voice in the matter. He thought they had considered a little too much that evening the decorative side of art training. The majority of children left school at the age of 11 or 12; and his experience was that children had not a great appreciation of beauty up to the age of 10. In order to decide what sort of instruction to give to children, they must ask—Why are children so fond of drawing? It was not because they were fond of decoration. Decoration was a conventional matter, and unintelligible to the vast majority of children. The love of drawing began about the age of two or three; children did not draw because they loved beauty, but they drew in the same way as savages did, because it offered the best means of describing the things which most interested them. If one could place oneself in the position of an infant, and imagine coming into the world, where things were strange and colours novel, and where you were constantly tumbling across something which surprised you, one would readily understand why it was that children liked colours and materials for drawing. At the age of eight or nine a child had seen most of the things

which was likely to surprise or astonish it, and then the love of drawing became less keen. The love of beauty came later, perhaps at the age of 15 or 16. He was not speaking of exceptional cases, but of the average child. If his idea was correct, he thought it would be a great mistake to insist too much on decorative training at an early age. Following out the idea of the reader of the paper that Board schools should be made attractive, and thus unconsciously give an æsthetic training, he ventured to offer the practical suggestion that diagrams and maps, and other artistic appliances, might very reasonably be improved. Many children at the age of six or seven were excellent colourists, but when they came to look at their atlases, their taste was ruined by the poor colouring to be found there. He would suggest that a crusade should be started in favour of more artistic maps and drawings. He would especially dwell upon the decorative part of training which was unsuitable for children in elementary schools. He thought drawing should be taught entirely from an educational point of view, in association with other subjects. This would be the best way of carrying on the development of innate art in children. He thought the reader of the paper was a little old-fashioned when he said that tears were necessary in connection with education. He could never understand why education should be made disagreeable. He found young children enthusiastic students; they were earnest in their investigations, and all they wanted was someone to give them the information they sought. How came it that after a child arrived at the age of 12 or 13 he was most often absolutely callous; knowledge was to him something hateful and a thing to be avoided? It was because they had thought too much of the pill in connection with education. There were lots of other ways in which discipline and duty might be impressed on children. The great object should be to cultivate a love of learning. If this were done, there was no doubt that education would go on properly, even after school life. Children should be treated as human beings. He thought if children could stick up for themselves, the schools would be very different from what they now are. The only fears he had in connection with the excellent paper was that it might press too heavily on the decorative side of art training.

Mr. H. STANNUS confessed to a feeling of disappointment with the paper. In listening to it he thought, with regard to the first portion, that they might be at a Diocesan Conference; when they got to the second portion he did not know what to make of it, and only when they got to the last would it be discovered that they were in the Applied Art Section of the Society of Arts. Mr. Image had very clearly shown how applied art would undoubtedly have an influence for good on the children; and so far as his remarks had reference to that, he was entirely in accord. He was very much interested to hear Mr.

Ablett differentiate about the age of children; and there his experience entirely coincided, that children were first of all interested with the objects that lived and moved about them, and it was only afterwards that they admired the objects which had beauty. The sense of beauty of form had to be developed. Mr. Image had confined his paper to the æsthetic side, but there was a great deal to be said for the decoration of school-houses on the storiation side. He had no sympathy with people who had been demanding economy in the Board schools. If these schools were made beautiful, it would be the means of educating children just as much as by book-learning. It was important that children who were drawn, as they must be, from the poorer classes should be surrounded by things of beauty in the Board school, so that they might unconsciously be taught to admire them. Money spent in decorating schools was well spent, as it would have an important bearing on the decorative art of the country. He hoped that everyone would agree with the suggestions for improving the decorations of class-rooms by means of inscriptions, pictures, and casts, as the fact of surrounding children with ugly things dulled their sense of beauty. In decorating schools he considered that if flowers, birds, and animals were used, that they should be painted in proper colours, and the name and description placed underneath. By so doing they would not only be teaching children what was beautiful, but what was an important end of education, namely, the power to observe and store up facts in their memory. If the result of the paper should be to draw more attention to this value of decorative art in education, he thought it would have achieved a good end.

Rev. STEWART HEADLAM said he agreed with all Mr. Image had said, but if it was to be carried out, a great deal of conversion of the members of the London School Board would have to take place. There were some members on the Board who did not think much of art at all; those who were keen about pictures wished to have pictures directly for instruction and for teaching certain facts, but very few took the line which Mr. Image had taken, that art should be used for decorative purposes. If they wished to get that thoroughly understood by the people who elected members of the School Board, they would have to work pretty hard. He was not sure that some of those who had spoken that evening were not in the same condition as many members of the Board. The last speaker said the representations of birds should be true, and so on, but when he got Mr. William Morris to have stuffs put on the wall, many members objected on the ground that they were not true to nature. The same remark applied to pictures; they were objected to unless they illustrated some historical fact. In Board schools all the boys, and most of the girls, were taught drawing; even infants had some little exercise in this direction, and the

work done was often exhibited. The work was mainly done with the object of training the eye and hand. It had been said that the Board did not give the children such good models as they ought to, but it must not be forgotten that the Board was under the tyranny of South Kensington. Notwithstanding this tyranny, the Board did its best with what was given them, and some very good work was often accomplished by the children. There was one mistake which was often made in connection with Board schools. It was said they were for the gutter children who lived in dens, but this was not so; they were really for the children of the people. He thought if the paper could be brought before the attention of the teachers in Board schools that a great deal of good would be done. It would be far better if the decoration could be essentially a part of the building; but then, again, that cost money, and objection was now taken to the cost of the schools. He hoped that at the next election a mandate would be given by the people that sufficient money should be spent upon school buildings. It was necessary that there should be a good deal of real—even painful—discipline in school work, and therefore they should do all they possibly could to make the rooms in which the children were taught as beautiful as possible.

Mr. H. BLACKBURN said he had great respect for Mr. Image's capabilities for design and decoration, and he came there that evening in the hope that they would see something on the walls of the kind of decoration proposed. He had not been altogether carried away by the polished eloquence of the paper; he tried to glean a little of what Mr. Image aimed at, and, so far as he could judge, the recommendation was to have structural decoration in the rooms of the Board schools, where it could be obtained. But he would suggest that, first of all, the designs should be marked distinctly, as to the materials for which they were intended. The designs for iron work should be in one portion, the designs for wood in another, and for pottery in another, so that in the early stages of life children might glean something (unconsciously, perhaps) of the kind of decoration most appropriate, which could be followed out in after life. He was assuming a time, not far distant, when children, passing from the Board school, would go, naturally and properly, to be taught decorative art at South Kensington. In Board schools, children should be surrounded with the kind of ornamentation most suggestive to them, and at the same time not obtrusive; and in carrying out this idea masters and mistresses should have some knowledge of design. Carrying this still further, one could easily suggest that Mr. Image should be called on to help forward any such proceeding.

On the motion of the CHAIRMAN, a cordial vote of thanks was accorded to Mr. Image for his able and interesting paper, and the meeting adjourned.

Journal of the Society of Arts.

No. 2,171. VOL. XLII.

FRIDAY, JUNE 29, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Proceedings of the Society.

CONVERSAZIONE.

The Society's annual *Conversazione* was held at the Imperial Institute, South Kensington, on Friday last, 22nd inst., and was attended by 2,714 visitors.

The principal galleries of the Imperial Institute were open, including those containing the collections illustrating the natural resources of the Colonies and India, and the Exhibition of British Artistic and Decorative Pottery, China and Glass, &c.

The reception was held in the Vestibule by Sir Richard Webster, G.C.M.G., Q.C., M.P., Chairman, Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Deputy - Chairman, and the following Vice - Presidents and Members of Council:—Sir Frederick Abel, K.C.B., D.C.L., F.R.S., George Ledgard Bristow, Francis Cobb, Sir John Donnelly, K.C.B., Sir Henry Doulton, Prof. C. Le Neve Foster, D.Sc., F.R.S., Sir Stuart Knill, Bart., Sir Frederick Leighton, Bart., P.R.A., J. Biddulph Martin, John O'Connor, Wm. H. Preece, C.B., F.R.S., Sir Owen Roberts, M.A., D.C.L., Professor W. C. Roberts-Austen, C.B., F.R.S., and Sir Saul Samuel, K.C.M.G., C.B.

Ashton's Blue Hungarian Band performed in the Vestibule, and promenade concerts were given by the Band of the Grenadier Guards (conductor, Lieut. Dan Godfrey) in the West Gardens, which, with the East Gardens, were specially illuminated for the occasion by Messrs. Pain, and by the Band of the Royal Artillery (conductor, Cavaliere L. Zaverthal) in the Indian Pavilion. The programme of music was as follows:—

BLUE HUNGARIAN BAND.

1. Turkish March Szabadi.
2. Valse ... "Christopher Columbus" ... Coote.
3. Mazurka ... "La Czarina" ... Ganne.
4. Overture ... "Portici" ... Auber.
5. Potpourri ... "Wiener Lieder" ... Czernak.
6. Valse Waldteufel.

7. Polka ... "The Train leaves" ... Dubecre.
8. Valse ... "Touristen" ... Ziehrer.
9. Overture ... "Dichter und Bauer" ... Suppé.
10. Russiche ... "Lieder" ... Ivanovici.
11. Lancers ... "Christopher Columbus" ... Coote.
12. March ... "Rackozy" ... Czinkapana.

BAND OF THE ROYAL ARTILLERY.

1. March ... "Unter dem Doppel Adler" ... F. Wagner.
2. Overture ... "Undank" ... Storek.
3. Valse ... "Morgenblätter" ... Strauss.
4. Song ... "An Old Garden" ... Hope Temple.
(Cornet Solo.)
5. Selection ... "I Pagliacci" ... Leoncavallo.
6. Idyll ... "Evening Breeze" ... Langey.
7. Song "Ho! ho! hear the wild wind blow" Mattei.
(Euphonium Solo.)
8. Gavotte Louis XIII.
9. Selection ... "Aïda" ... Verdi.
10. "Love's Dream after the Ball" Czibulka.
11. "La Zamaceuca" ... Rittei.
12. Selection ... "Masaniello" ... Auber.

BAND OF THE GRENADIER GUARDS.

1. March ... "Under the Double Eagle" F. Wagner.
2. Overture ... "La Gazza Ladra" ... Rossini.
3. Selection "Paderewski's Compositions" Paderewski.
4. Valse ... "Eva Töchter" ... Ziehrer.
5. March ... "Austria" ... Nowotny.
6. Cornet Solo ... "Lebewohl" ... Kücken.
(Sergeant Knight.)
7. Selection ... "Lieder ohne Worte" ... Mendelssohn.
8. Selection "Little Christopher Columbus" Caryll.
9. Scenes Pittoresques... .. Massenet.
(1. Marche. 2. Angelus. 3. Fête Bohême.)
10. Valse ... "Gebirgskinder" ... Ziehrer.
11. Selection ... "A Gaiety Girl" ... Sidney Jones.
12. Dance Music "King Henry VIII," ... E. German.
13. Selection ... "Venice in London" ... Venanzi.
14. March ... "Tannhäuser" ... Wagner.

God Save the Queen.

The District Railway, as on former occasions, allowed the free use of their subway to visitors coming by railway.

ANNUAL GENERAL MEETING.

The Annual General Meeting, for receiving the report from the Council, and the Treasurers' Statement of Receipts, Payments, and Expenditure during the past year, and also for the Election of Officers, was held, in accordance with the Bye-laws, on Wednesday last, the 27th June, at four p.m., Sir RICHARD WEBSTER, G.C.M.G., Q.C., M.P., Chairman of the Council, followed by Sir HENRY DOULTON, in the chair.

The SECRETARY read the notice convening the meeting, and the minutes.

The following candidates were proposed, balloted for, and duly elected members of the Society:—

Armstrong, Thomas, Science and Art Department, South Kensington, S.W.
 Bankes-Price, William Hughes, H.B.M.'s Vice-Consul, Chicago, Ill., U.S.A.
 Blackwell, George Grove, jun., Messrs. George G. Blackwell, Sons, and Co., 25, Irwell-chambers West, Liverpool.
 Bram, Sydney Arthur, 18, Huntsmoor-road, Wandsworth, S.W.
 Calvert, Albert Frederick, The Mount, Oseney-crescent, Camden-road, N.W.
 Churchill, Lady Alfred S., 16, Rutland-gate, S.W.
 Collins, Edward, 51, Pelham-road, South Wimbledon.
 Cuthbertson, Sir John Neilson, J.P., D.L., 25, Blythswood-square, Glasgow.
 Dixon, Arthur, 26, Berkeley-square, W.
 Dodson, Henry Percy, Reuter's Telegram Company, 24, Old Jewry, E.C., and 41, Courtfield-gardens, S.W.
 Drake, Charles Alexander, Three Mills Distillery, Bromley, Bow, E.
 Fox, Stephen Newcome, 12, Cromwell-crescent, S.W.
 Graesser, R., Chemical Works, near Ruabon, North Wales.
 Hanson, Charles A., 49, Holland-park-road, W.
 Head, Charles Arthur, Hartham-hall, Stockton-on-Tees, and Arncliffe-hall, Northallerton.
 Heaton, Aldam, 29, Bloomsbury-square, W.C.
 Hole, James, 1, Great College-street, Westminster, S.W.
 Iron, William, Vestry-hall, Clerkenwell, E.C.
 Leventhorpe, Algernon, Akyab, Burma, and care of Messrs. Henry S. King and Co., 45, Pall-mall, S.W.
 Livesey, Frank, 709A, Old Kent-road, S.E.
 Murray, Lieut.-Colonel Henry, 43, Cromwell-houses, Queen's-gate, S.W.
 Paul, Matthew, Junr., Levenford Works, Dumbarton, and Alcluth, Dumbarton.
 Peace, Walter, C.M.G., 64, Victoria-street, S.W.
 Pharo, J. Crawford, 18, Shooter's-hill-road, Blackheath, S.E.
 Prideaux, Sir Walter S., Goldsmiths'-hall, Foster-lane, E.C.
 Wall, Thomas, 113, Jermyn-street, S.W.
 Williams, Thomas David, Egremont, The Ridge, Hastings, Sussex.
 York, H.R.H. the Duke of, K.G., York-house, St. James's-palace, S.W.

The Chairman nominated Mr. John Leighton and Mr. John Jewell Vezey scrutineers, and declared the ballot open.

The SECRETARY then read the following

REPORT OF COUNCIL.

I.—ORDINARY MEETINGS.

In accordance with the usual practice, the Session was opened with an address from Sir

Richard Webster, the President of the Council. In addition to dealing with the work of the Society during the past Session and for the future, the Chairman selected, as the principal topic of his address, the Chicago Exhibition, the subject which, for the past three years, has occupied so much of the attention of the Society. The address was illustrated by a number of photographic views of the principal buildings of the Exhibition.

Three weeks later, the account given by the Chairman was supplemented by a paper by Mr. Frederic Villiers, on "An Artist's View of Chicago and the World's Fair." Mr. Villiers had spent some time in Chicago, as correspondent for one of our principal pictorial papers, and he was able to illustrate his remarks with photographs taken by himself on the spot, and reproductions of his own sketches.

Two other papers which were read during the Session dealt, to a certain extent, with matters connected with the Exhibition, that by Mr. Herbert Thrupp on "American Carriages," and the one by Mr. Charles P. Oldham on "Californian Wines." Mr. Thrupp had been in Chicago as one of the English judges, and Mr. Oldham had also visited the Exhibition, and had prepared a special report on the "Wines of California" for the Commission, which report was printed in the *Journal* for January 5th, 1894.

An unusually large proportion of the papers read before the Society during the past Session dealt with matters of an artistic character. The first of these was Capt. M. H. Hayes's paper on "The Horse from an Artistic Point of View." Capt. Hayes discussed the question, which may be said to have been started by the photographs taken by Mr. Muybridge about 15 years ago, as to how far an artist should reproduce the actual motions of the horse, as shown by instantaneous photographs, and how far he should submit to the conventional representation. The next paper in the artistic class was the one read by Mr. Richardson Evans on "Architecture and Advertisements." Mr. Evans animadverted strongly on the manner in which the streets of our cities and the fields of the country are defaced by advertisements, and expressed a hope that legislative means would be found for remedying what has certainly become an abuse.

Mr. Charles L. Burdick, in his paper on "The Fountain Air Brush," gave a description of the very ingenious apparatus, by means

of which the artist is enabled to use a jet of spray in place of a brush or crayon. Mr. C. F. Binns, one of the well known family of that name, who have so long been associated with the Royal Worcester Porcelain Works, in his paper on "The Elements of Beauty in Ceramics," discussed generally the principles by which the artistic potter should be guided. The paper led to an interesting discussion, which, on the whole, was favourable to the suggestions put forward by Mr. Binns. Mr. Alexander Millar's paper, on "Design in Modern Carpets," was fully illustrated, not only by recent carpets of considerable artistic merit, but by examples of carpets of a generation back, showing the faults and deficiencies in the designs of carpets at that time.

Papers dealing with Electrical subjects were less numerous than in some recent Sessions. There was an important paper by Mr. W. H. Preece, on "Electric Signalling without Wires," in which the author gave an account of the experiments he has been conducting for some little time past with the view to the transmission of electric signals over spaces which cannot be bridged by a wire, such as spaces between a lightship or lighthouse and the shore, or even between a ship and the shore. The other paper dealing with an Electrical subject was by Mr. Henry Robinson, and in it an account was given of the St. Pancras Electric Light Installation.

Three papers were read dealing with Applied Chemistry. Mr. A. P. Laurie, whose researches on artist's colours are well-known to the Society, read a paper upon "White-lead Substitutes," in which he gave the results of his recent work on the various materials which have been suggested for use in place of white-lead in the manufacture of white paint. Professor Vivian B. Lewes's paper on "London Coal Gas and its Enrichment" may be considered as a continuation of his last year's course of Cantor Lectures. Mr. Chapman Jones's paper on "Some Recent Developments of Photographic Chemistry" discussed the various methods now employed for development, and also the processes available for the intensification of the silver image originally obtained. It included the results of some original work done by Mr. Jones in this direction.

Mr. Lewis H. Isaacs's paper on "Carriage-way Pavements for large Cities" attracted a great deal of attention from those who are interested in this important subject, and led to

a discussion to which a second evening had to be devoted.

Mr. W. Worby Beaumont described his ingenious method of balancing reciprocating machinery and preventing vibration in his paper on that subject. Mr. G. J. Symons gave a very interesting account of the work to which he has devoted his life, in his paper on "Rainfall Records in the British Isles," and described the very complete organisation which, thanks to his energy and ability, has been developed, without Government assistance, for collecting information on this important national subject, from every part of the country.

Professor Carl Linde, in his paper on "Refrigerating Apparatus," explained the theoretical principles which form the basis of the various methods now employed in the manufacture of such machinery. Mr. A. G. Charleton's paper on "Nickel" was a useful account of the geology of that substance and its distribution. Members who are interested in the matter will look forward to a second paper, in which Mr. Charleton has undertaken to deal with the metallurgy of the metal. Colonel H. L. Wells's paper on "Telegraphs and Trade Routes in Persia" had to be read in the absence, through illness, of its author, but it gained in interest from the account by Sir Frederic Goldsmid of his earlier experiences in the establishment of the telegraph in Persia.

The last paper read was by Mr. Stockfleth, on "Liquid Fuel." In it the author dealt with the production and applications, mainly, of Russian petroleum.

II.—INDIAN SECTION.

The interest felt in this department of the Society's work has been well maintained during the year. The papers and discussions, particularly those more immediately concerned with the development of the industrial resources of India, have attracted considerable notice, and cannot fail to be of great value to our eastern Empire.

The Session opened on the 18th of January, when an experienced officer of the Indian Geological Survey, Mr. R. D. Oldham, gave an interesting description of the present condition and probable future of the petroleum fields of India. The conclusion Mr. Oldham arrived at is that, although considerable expansion may be looked for in Assam and Burma, there seems no reason to anticipate that India will ever rank with Russia and America as

one of the great petroleum exporting countries of the world. On February 8, Mr. E. O. Walker read a paper on "Telegraphic Communication between England and India: its present condition and future development." Speaking with a full knowledge of the subject, gained by long connection with the Indian Telegraph Department, Mr. Walker urged that a reduction of rates is both desirable and practicable; a view that would appear to be supported by all the Indian Chambers of Commerce. On February 15, Mr. John Alfred Gray, who had just previously returned from Cabul, gave the Section a picturesque and detailed account of his experiences in the service of the ruler of that country, Amir Abdurrahman, throwing light on the condition of a country which, as the chairman (the Hon. George Curzon) observed, has, since the last Afghan war, been almost a *terra incognita* to Englishmen. On March 8, Mr. J. Barr Robertson followed up the paper he contributed last year by one on "The Indian Currency," treating the subject in an exhaustive manner. The discussion, which was opened by the Right Hon. Henry Chaplin, M.P., had to be adjourned, on account of the number of gentlemen wishing to take part, among the speakers being Sir Raymond West, Sir W. H. Houldsworth, Sir Guilford Molesworth, Mr. R. L. Everett, Mr. R. Barclay Chapman, Mr. Herbert Gibbs, Mr. Lesley Probyn, and Sir Alexander Wilson. On March 19, Mr. Joseph Walton read a paper advocating a rapid extension of Indian railways, and on April 26, Sir Auckland Colvin favoured the Section with a most able paper on "Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh," the contribution forming a valuable addition to the paper read before the Society, in 1888, by Sir Henry Cunningham, on "Public Health in India," and that read by Surgeon-General Sir William Moore, in 1892, on "Indian Sanitation and the International Congress of Hygiene." The Session was fittingly closed on the 24th of May by an excellent paper on "The Commerce of Siam in Relation to the Trade of the British Empire," contributed by Mr. Charles Stuart Leckie, of the Borneo Company, Bangkok, now on a short visit to this country. Of the above, three, namely, those of January 18, February 8, and March 19, were held by arrangement with the Council of the Institute, in the temporary Grand Hall of the Imperial Institute.

III.—FOREIGN AND COLONIAL SECTION.

Six meetings of this Section have been held. The first meeting took place on January 23rd, when Captain Charles Rolleston read a paper on "Morocco and its Races." He spoke in high terms of the climate of this country, and described a tour through the Reef territory, which, though situated within view of the Mediterranean Sea, has only once been visited by a European. On February 20th a paper was read by Monsieur Edouard Sève, Vice-Consul for Belgium, on "The Arts and Industries of Belgium, and the Antwerp Exhibition." Monsieur Sève made an earnest appeal to British manufacturers to participate in this Exhibition, an appeal which was endorsed by Sir Albert Rollit, who presided at the meeting. On March 16th Monsieur Edouard Foa gave an interesting account of a journey he had recently undertaken in the basin of the Zambesi, for the purpose of reporting upon the resources of that district. The late Captain Lovett Cameron, who presided, confirmed Monsieur Foa's high opinion of the future of the Zambesi. On April 19th Mr. George Collins Levey read a paper entitled "Tasmania, and the forthcoming Hobart International Exhibition." Mr. Levey traced the development of this colony from its foundation to the present time, and dwelt upon its fertility of soil, its mineral wealth, and the beauty of its scenery. On May 25th Mr. James Inglis, President of the Sydney Chamber of Commerce, read a paper on "New South Wales," with special reference to the present conditions of trade in that colony. The concluding paper was read on May 29th by Mr. W. A. Wills. It was entitled "Black and White in Afrikanerland," and in it he described the various European and native races of South Africa.

IV.—APPLIED ART SECTION.

Mr. Percy Fitzgerald read at the first Meeting of this Section an exhaustive paper on "The Adam Architecture in London," the result of a life-study of the numerous buildings erected in London and elsewhere by the brothers Adam; a subject of especial interest to the members of the Society of Arts, as the Society's house is a good specimen of the work of the Adams, and is situated in the district created by them. The paper was illustrated by a remarkable series of lantern slides of elevations, interiors, and furniture designed by the brothers.

At the second Meeting, Mr. Horace Townsend read a paper on the "Modern Development of Illustrated Journalism," in which he described the great advances made in the rapid production of blocks, and the increased use of colour printing for newspapers in the United States. In the full discussion which followed the reading of the paper, various opinions were expressed as to the advantages or otherwise of illustrated daily papers.

Mrs. Philip Newman read a paper on February 27th, on "Goldsmiths' Work: Past and Present," in which she gave an interesting account of ancient jewellery, and pointed out the need of artistic revival in the productions of the present age. The paper was illustrated by an important series of photographic slides of historical work, including some of the chief treasures of the Gold Instrument-room in the British Museum, which were photographed by Mr. Philip Newman.

Mr. Henry Balfour, curator of the Pitt-Rivers Museum at Oxford, read a paper at the fourth Meeting on "The Evolution of Decorative Design," which formed a valuable contribution to the history of the growth of design, more particularly among uncivilised nations.

Pewter, an alloy of great interest and beauty, which has been allowed to go, to a great extent, out of use, formed the subject of a paper by Mr. J. Starkie Gardner, who has previously favoured the Society with valuable papers on wrought ironwork, bronze, and enamels. In the discussion, Mr. Gowland supplemented the full description in the paper of European pewter by an account of the use of this metal in Japan. A very fine collection of objects in pewter, from South Kensington Museum, were kindly lent by the Science and Art Department, to whom the Council is indebted for many important contributions lent on previous occasions. The Pewterers' Company and several private collectors also contributed a large number of beautiful objects.

At the last Meeting, Mr. Selwyn Image read a paper on "Decorative Art in connection with Elementary Education," in which he urged the cultivation of the æsthetic sense in children by the adoption of beautiful surroundings in their schools, and by the instilling into their minds from their earliest years the true principles of beauty.

V.—CANTOR LECTURES.

The first course of Cantor Lectures was by Mr. Henry Blackburn on "The Art of Book

and Newspaper Illustration." Eighteen years ago, in 1875, Mr. Blackburn, in a paper read before the Society, pointed out how much might be done in the way of rapid newspaper illustration of passing events, and he was now able to show what great progress had been made in the direction which he had indicated during the period which has passed since the reading of that paper.

Professor Frank Clowes's course on "The Detection and Measurement of Inflammable Gas" was to a large extent an elaboration of the interesting paper which he read before the Society in the previous Session, and in which was described the method he has invented and perfected for testing the amount of fire-damp or other explosive vapour in the air, by the use of a hydrogen flame burning in a safety-lamp.

Mr. Hugh Stannus' course on "The Decorative Treatment of Traditional Foliage" was a complement to the valuable course which he delivered in 1891 on "The Decorative Treatment of Natural Foliage." As the lecturer had previously dealt with the necessary arrangement of leaves in design, by which nature is brought into the artistic field, so in the present course he formulated the laws which must govern the successful use of artificial foliage in decoration, laws which are founded on the study of natural forms, and prohibit the use of that which is opposed to nature.

Captain Abney, to whom the Society is so much indebted for many previous papers and lectures, gave a very valuable and interesting course on "Photometry," in which he described the principal methods now employed for the measurement of light, and showed how much had yet to be done before an accurate measure of light could hope to be obtained. His treatment of a well-known subject was marked by the originality which characterises all Captain Abney's work.

In the concluding course Mr. H. C. Jenkins gave an account of the principal Typewriting Machines which have come into use up to the present time, and traced the development of the apparatus from the early efforts of Wheatstone and Pratt down to the complete and highly elaborated machine now employed.

VI.—JUVENILE LECTURES.

The Juvenile Lectures for the present year were by Mr. Walter Gardiner, his subject being "Plants: their Foes and Defences." Mr. Gardiner showed the various devices which had been developed by plants for the

propagation of their species and their defence, and illustrated, by a large collection of very beautiful lantern slides, the relation between plants and insects.

VII.—ALBERT MEDAL.

The Albert Medal for the present year has been awarded to Sir Joseph Lister, for "the discovery and establishment of the antiseptic method of treating wounds and injuries, by which not only has the art of surgery been greatly promoted, and human life saved in all parts of the world, but extensive industries have also been created for the supply of materials required for carrying the treatment into effect."

Sir Joseph Lister is entitled to the credit of having been the first to recognise the full significance of Pasteur's work in relation to the growth of bacterial germs, and to apply in practice the principles which this work established. The resulting "antiseptic" method of treating wounds and injuries has greatly enlarged the field of surgery by rendering it safe to perform operations which, a few years ago, would certainly have been attended by fatal consequences, and it has enormously diminished the mortality arising either from operative or from accidental injuries. It has brought about the establishment of considerable industries, in all civilised countries, for the supply of instruments, chemicals, and fabrics adapted to its requirements; and it has led to the general application of bactericides for the purposes of sanitation.

VIII.—MEDALS FOR PAPERS.

The Council have awarded the Society's Silver Medal to the following readers of Papers during the Session 1893-94 :—

At the Ordinary Meetings :—

To LEWIS H. ISAACS, for his paper on "Carriageway Pavements for large Cities."

To W. WORBY BEAUMONT, for his paper on "Automatic Balance of Reciprocating Machinery, and the Prevention of Vibration."

To G. J. SYMONS, F.R.S., for his paper on "Rainfall Records in the British Isles."

To PROF. VIVIAN B. LEWES, for his paper on "London Coal Gas and its Enrichment."

To CHAPMAN JONES, for his paper on "Some Recent Developments of Photographic Chemistry."

In the Indian Section :—

To JOHN A. GRAY, for his paper on "Experiences at the Court of Afghanistan."

To SIR AUCKLAND COLVIN, K.C.S.I., K.C.M.G., C.I.E., for his paper on "Municipal and Village Water Supply and Sanitation in the North-West Provinces and Oudh."

To C. S. LECKIE, for his paper on "The Commerce of Siam, in Relation to the Trade of the British Empire."

In the Foreign and Colonial Section :—

To EDOUARD SEVE, for his paper on "The Antwerp Exhibition, 1894."

To JAMES INGLIS, for his paper on "New South Wales."

In the Applied Art Section :—

To PERCY FITZGERALD, M.A., for his paper on "The Adam Architecture in London."

To HENRY BALFOUR, M.A., for his paper on "The Evolution of Decorative Art."

To J. STARKIE GARDNER, for his paper on "Pewter."

The thanks of the Council were voted to W. H. Preece, C.B., F.R.S., for his paper on "Electric Signalling without Wires," since Mr. Preece, being a member of the Council, was not eligible to receive a medal.

IX.—SWINEY PRIZE.

The quinquennial award of the Swiney prize was made last January. Dr. Swiney died in 1844, and in his will he left the sum of £5,000 Consols to the Society of Arts, for the purpose of presenting a prize, every fifth anniversary of the testator's death, to the author of "the best published work on Jurisprudence." The prize is a cup value £100, and money to the same amount; the award is made jointly by the Society of Arts and the College of Physicians. The cup now given is in accordance with a design specially prepared in 1849 for the first award, by Maclise.

Following the usual practice, a joint Committee of the Society of Arts and the College of Physicians considered the award, and on their report the prize was awarded to Thomas Erskine Holland, D.C.L., of Lincoln's-inn, Barrister-at-Law, Chichele Professor of International Law in the University of Oxford, for his work entitled "Elements of Jurisprudence," by a meeting of the adjudicators held on the 22nd January last.*

The following is a list of the recipients of the Swiney Prize up to the present date :—

1849. J. A. Paris, M.D., and J. Fonblanque, for their work, "Medical Jurisprudence."

1854. Leone Levi, for his work, "The Commercial Law of the World."

* See *Journal* 26th January, 1894.

1859. Dr. Alfred Swayne Taylor, F.R.S., for his work, "Medical Jurisprudence."
 1864. Sir Henry Sumner Maine, K.C.B., D.C.L., member of the Legislative Council of India, for his work, "Ancient Law."
 1869. William Augustus Guy, M.D., for his "Principles of Forensic Medicine."
 1874. The Right Hon. Sir Robert Joseph Phillimore, D.C.L., for his "Commentaries on International Law."
 1879. Dr. Norman Chevers, for his "Manual of Medical Jurisprudence for India."
 1884. Professor Sheldon Amos, for his work, "A Systematic View of the Science of Jurisprudence."
 1889. Charles Meymott Tidy, M.D., for his work, "Legal Medicine."
 1894. Professor Thomas Erskine Holland, D.C.L., for his work, "The Elements of Jurisprudence."

X.—PRIZE FOR A SILVER CUP.

Being anxious to obtain a more suitable design for the Swiney Cup, the Council of the Society have offered to award a prize of £25 for the best design for a silver cup of the value of £100. The design, if adopted, will be used for the Swiney Prize. The offer is open to all students of schools of art in the United Kingdom. Competing designs should be sent in not later than the 31st December, 1894, addressed to the Secretary, Society of Arts, Adelphi, London.

Further particulars have been announced in the *Journal*,* and can be obtained on application to the Secretary.

XI.—OWEN JONES PRIZES.

This competition was instituted in 1878, by the Council of the Society of Arts, as trustees of the sum of £400, presented to them by the Owen Jones Memorial Committee, being the balance of subscriptions to that fund, upon condition of their expending the interest thereof in prizes to "Students of the School of Art who, in actual competition, produce the best designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones." The prizes are awarded on the results of the annual competition of the Science and Art Department.

Six prizes were awarded this Session in the present year, each prize consisting of a bound copy of Owen Jones's "Principles of Design," and a Bronze Medal.

The list of the successful candidates was given in the *Journal*, July 28, 1893.

The next award will be made this summer, on the result of the present year's examinations. Six prizes have again been offered for competition.

XII.—MULREADY PRIZE.

The balance of the amount collected for a monument to Mulready was handed over to the Society in 1875, with the understanding that the interest would be expended in keeping the monument in repair, and in occasional prizes to art students.

From this fund a prize of £20 was awarded in 1892, and a similar prize was awarded in 1893, for a drawing from the nude living model, to William J. Smith, of the School of Art, Leicester. In both cases the awards were made on the recommendation of the Department of Science and Art.

XIII.—JOHN STOCK PRIZE.

The Society are trustees, under the will of John Stock (dated October, 1781), of a sum of £100, the interest on which is to be expended for the promotion of drawing, sculpture, and architecture. As the accumulation permits, various prizes are offered under the Trust. Last year a Gold Medal, or a prize of £20, was offered to the student of a School of Art who shall send in, at the competition of 1893, the best original design for an architectural decoration, by means of painting, stucco, carving, mosaic, or any other processes. The Council of the Society, acting on the recommendation of the Department of Science and Art, awarded the prize, for a design for architectural decoration, to William Amor Fenn, of the Goldsmiths' Institute, New-cross, S.E., for his design for the decoration of the hall of a private mansion.

XIV.—PRIZES FOR DRAWING.

Since 1889, the Council have placed at the disposal of the Royal Drawing Society, for competition among the candidates at its annual examination, 12 Bronze Medals, and, as usual, these medals were awarded for drawings sent in by students to the exhibition held by the Drawing Society in April last. The object of the Society is to encourage the teaching of drawing in secondary and higher grade schools, and this, during the five years' of its existence, it has satisfactorily done. Last, and this year, it has extended its work to the great public schools, and contributions from pupils in these were included in its exhibition on both occasions. This offer of the medals has been renewed for next year.

* See *Journal*, May 18, 1894.

XV.—EXAMINATIONS.

The increase which has been shown of recent years in the number of candidates entering for the Society's examinations still continues, and is a gratifying testimony to the value of this part of the Society's work.

It was mentioned, in the Report for 1892, that the number of candidates in that year reached a higher point than it had ever touched since the institution of the examinations by the Society in 1856—2,928 having presented themselves at the examination in 1892. The greatest number ever previously examined was in 1869, when 2,160 came up. At that time the examinations were free, and there was a choice of 36 subjects. In the same year (1892) a special examination was held in the autumn for School Board teachers, and 423 candidates were examined. The total number of persons examined by the Society during the year was, consequently, 3,351. In the following year (1893), this number was exceeded, for there was 3,702 candidates; but, in the present year, a still greater growth is to be noticed, and the large total has been reached of 4,106.

A comparison of the results for the past five years is given in the following short Table,

Year.	No. of Candidates.	No. of Papers worked.	No. of Centres.	No. of Sub-jects.
1890....	2,315	2,474	79	14
1891....	2,460	2,667	78	14
1892....	*2,928	3,143	96	13
1893....	3,702	3,916	109	13
1894....	4,106	4,375	131	14

* Total, with autumn examination, 3,351.

which also shows the number of centres at which the examinations were held. This number has increased from 79, in 1890, to 131 in the present year. This large and satisfactory increase is certainly due principally to the fact of technical instruction having been taken up by the County Councils, in consequence of the Customs and Excise Act of 1890 having placed at the disposal of those bodies the money which had been raised by the spirit duty, and which Parliament had refused to apply to the purpose for which it had been raised, namely, the compensation of the holders of licenses. The subjects in which

the County Councils desired to give instruction were, to a very large extent, the same as those in which the Society holds examinations; and the fact that these examinations provided a valuable test for the results of the teaching given in the classes founded by the County Councils, accounts for the very large increase in the number of candidates, and the still greater proportionate increase in the number of examination centres.

It is also certain that a proportion of the increase is due to the offer of prizes in connection with the examinations. In 1890 the Council determined to offer for competition, at the examinations of 1891, a limited number of Bronze Medals in each subject. In addition to these, certain of the City companies provided funds, out of which special money prizes were provided. The Clothworkers' Company offered prizes in Italian and Spanish, and the Companies of Goldsmiths, Mercers, Skinners, and Salters gave donations which enabled the Council, during the past four years, to provide prizes for English, Commercial Geography, French, German, and Portuguese. These prizes have been offered and awarded each year, with excellent results, since 1891, and, for the coming year, the Clothworkers' Company have liberally increased the amount of their donation, so as to provide special prizes for Portuguese. The funds given by the other City companies have now been exhausted, but it is to be hoped that the companies, seeing that definite and good results have been attained with comparatively trifling expenditure, may be willing to renew their grants for the next and future years.

As has been the case for some years, the greatest number of candidates came up in Book-keeping, the large number of 2,126 papers having been worked in this subject, an increase of 320 over last year. The examiner remarks that a smaller proportion of students than usual reached the higher ranks of certificate, only 8.37 per cent. having taken first-class certificates, whereas the percentage of the previous ten years was 12.36. 10.02 per cent. were not passed, the ten year average being 8.6.

Arithmetic is one of the few subjects in which a decline in numbers is shown, only 81 candidates having entered for it. The falling off in this number has been tolerably steady for the past five years, a fact which appears to be due to the rather high standard which has been set in this subject.

It is hardly necessary to remark upon the

importance of candidates taking the subject up, or on the undesirability of their being deterred by the maintenance of a reasonably high standard. It is, however, satisfactory to note that the examiner remarks that insufficiently prepared candidates did not present themselves in such numbers as heretofore. The per-centage of failures, which has been steadily falling for the last few years, again shows a considerable diminution. Some of the papers were clearly expressed, accurate, and well reasoned; on the other hand there were also papers which, in the opinion of the examiner, showed ignorance, disorder, and incompleteness of work. The number, however, of utterly trivial papers was fewer than formerly.

For Commercial Geography there were 30 candidates, a trifling increase on last year, when there were 24, but not equal to the year before, when there were 32. The examiner reports the result of the examination as satisfactory. Evidence of careful preparation was shown in almost every case, and many of the low marks were due to the correct reproduction of facts from text-books which had got out of date.

The number of candidates in Type-writing shows a slight increase—174 as compared with 152 in 1893. The number of first-class certificates shows an advance upon former years. The examiner speaks well of the way in which the papers generally were dealt with, but deplors the lack of literary knowledge evidenced by the candidates generally; she points out that knowledge of this sort is as essential to a type-writer as to a printer.

The number of candidates in Shorthand is practically the same (805) as last year, when there were 803. The examiner reports that there is a marked improvement in this year's papers, both as regard the shorthand characters and the longhand transcripts. The number of papers worked by candidates unfit for examination is much fewer in number than was the case in previous years, although a few such papers are still sent in. The number of first-class certificates shows a gratifying increase over last year, while the proportion of rejections has considerably diminished.

The number of candidates in English shows an increase—178 compared with 143, the number, however, of first-class certificates is less than last year, and the number of failures, as the examiner points out, is exceptionally large. Although the handwriting is on the whole improved, and there are fewer mistakes in spell-

ing, there is a lamentable carelessness in expression, and much evidence of haste and inaccuracy in the preparation of work this year.

French shows a considerable increase on last year—235 against 198. The examiner found the average of work high, but no very marked excellence is shown. He thinks that many failures are due to inefficient teaching, and remarks that candidates do not study the works recommended, and consequently suffer from this indifference to guidance.

German shows the next largest number to French—140—five less than last year, although showing an increase on previous years. On the whole the examiner is able to note a decided general improvement, but points out the importance of a knowledge of German handwriting.

The increase in the number of candidates in Spanish, which has been noticed of recent years, still continues. 106—a large number for such a subject—presented themselves. The examiner notes that the candidates showed a knowledge of commercial technical terms, but the literary part of the examination was less satisfactory.

In Italian there were 19 candidates, an increase of 3 over last year. The examiner considers that the technical portion was satisfactory and that the results generally show a serious study of the language.

There were 13 candidates in Portuguese, last year there were none, in the year before 5. The examiner considers the results satisfactory. The papers showed a fair knowledge of the language. It may be that the offer of special prizes for this year in this subject, by the Clothworkers' Company, will attract more candidates, and of a higher class.

The offer to examine candidates in Russian, Danish, Chinese, and Japanese still remains ineffective.

The number of candidates in Domestic Economy shows a slight falling off. There were 128 this year, last year there were 149. The examiner finds that the improvement in the working of the papers has been steadily maintained, showing the increasing interest taken in the subject.

With regard to the Theory of Music examinations, both the subjects into which Music is divided—Rudiments of Music and Harmony and Counterpoint—show an increase. The examiner considers the elementary papers were generally very well worked. The higher papers were unevenly worked. In Harmony, the

examiner finds lack of preparation, although of the higher papers about half were skilfully answered.

XVI.—PRACTICAL EXAMINATIONS IN MUSIC.

It is not possible to give in the present Report an account of the results of the examinations this year, circumstances having rendered it necessary to fix the date of the examinations a little later than usual. They commenced on the 14th inst., and are not yet concluded. As soon as they are over, the usual summary of the results will be given in the *Journal of the Society of Arts*. 378 candidates presented themselves for examination, a considerable increase on the last or on any previous year, 312 being the number for last year, the highest attained up to that time. Sir Joseph Barnby and Mr. W. G. McNaught again served as examiners.

XVII.—MEMORIAL TABLETS.

The memorial tablet to Sir Rowland Hill, the founder of the Penny Post, on Bertram-house, Hampstead, which was referred to in the Report for 1892, was erected immediately after the last annual meeting. The house is now occupied by the North Western Hospital, and permission to erect the tablet was given by the Metropolitan Asylums Board. The tablet was unveiled by Miss Fellows, a granddaughter of Sir Rowland Hill, in the presence of several members of the Hill family and members of the Board of the hospital, on Thursday, 29th June, 1893.

XVIII.—CHICAGO EXHIBITION, 1893.

In the Report for the Session of 1891-92 an account was given of the preliminary steps which had been taken by the Council of the Society, acting as a Royal Commission for the Exhibition, for the organisation of the British Section. In the Report for the Session 1892-93 the account of the proceedings of the Royal Commission was brought down to the date of the opening of the Exhibition. It will not be necessary to continue the history in the present Report because the full Report of the Commission has already been issued, and was published in the *Journal* for the 18th of May last.

This Report recorded in detail all the steps which had been taken by the Commission for the management of the British Section, and it embodied also a good deal of information which it was thought would be serviceable whenever

preparations may be made for any future International Exhibition.

It would have hardly been possible, and it did not appear desirable, to go at any great length into matters extraneous to the British Section, such as the history of the Exhibition itself, or to discuss at length either the American organisation or the part taken in it by foreign countries. A very brief summary of the origin and organisation of the Exhibition, and a short account of the Exhibition Park and Buildings was, however, included, and a list of books was given in an Appendix, to which reference might be made by those desirous of further information. An effort, however, was made to include all information bearing on the British Section, or likely to be useful to those who have charge of a British Section in any future Exhibition.

A summarised account was given of the contributions of the British Colonies, though for detailed information on this head reference will have to be made to the Reports which, it is understood, will be issued by each of the Colonial Commissions. The only Report which appears to be published up to the present date is the one on Trinidad. Although the number of Colonies taking part in the Exhibition was less than had been represented at several previous Exhibitions, the area occupied at Chicago by Colonial exhibits was very greatly in excess of that filled in any previous International Exhibition.

The Appendixes published with the Report, besides giving lists of the British, Colonial, and American officials, a Synopsis of the Classification, and copies of the Regulations issued by the American Executive and by the Commission, included a Financial Statement, which showed in considerable detail the expenditure of the Commission, and a Table comparing this expenditure with that of the Commissions for previous Exhibitions; there was also a statement of the grants made by foreign Governments, so far as they could be ascertained, amounting in all to about one million and a half sterling. Another Appendix gave a list of those exhibitors in the British Section to whom awards had been made. A list of the awards, arranged according to the classification of the Exhibition, had previously been issued in the *Journal* of the 20th of April. There were, in all, 34 Appendixes.

The Report gives the total outlay by the American Executive upon the Exhibition as about six millions sterling; another million and a half was provided by foreign Govern-

ments. To ascertain the total cost there will have to be added to these amounts the expenses incurred by individual exhibitors. These can only be vaguely estimated. So far as can be ascertained, the amount expended by British exhibitors was estimated at about £208,000; this would make the total cost of the British Section between £260,000 and £270,000. It is probable that this proportion of individual to Government expenditure would not hold good for other countries in which the Government grant was much higher, and, in all probability, the individual expenditure of the exhibitors proportionately smaller. Supposing that foreign exhibitors contributed a million, and American exhibitors a million and a half, the total amount expended on the Chicago "World's Fair" may be set down as ten millions, and very likely this estimate is not very far out. It is certainly under rather than over the mark.

It is certain that the work undertaken by the Council of the Society on behalf of the country was a very difficult one, perhaps more difficult than in the case of most previous Exhibitions. The larger sums given by Foreign Governments made competition more severe; the great distance to Chicago, and the long journey from the coast introduced special difficulties, and involved heavy expenditure; the strict protective policy of the United States, and their high Customs' duties gave occasion for a much more elaborate system of Customs' inspection than had been known or considered necessary on previous occasions; while the unfortunate financial crisis through which America passed in the autumn of last year, had a disastrous effect on the immediate profits of exhibitors, both in the Industrial and in the Fine Arts Department.

In spite, however, of all difficulties the Council believe that they have a right to congratulate the Society upon the manner in which the work has been carried out, and that by allowing its Council to act as a Royal Commission for the Chicago Exhibition, the Society has added one more to the many public services it has rendered during the long period of its existence.

XIX.—CONVERSAZIONE.

The experiment tried last year of holding the *Conversazione* at the Imperial Institute was considered sufficiently successful to justify the Council in applying to the Council of the Imperial Institute for the loan of the building for the *Conversazione* of the present year.

Permission was granted, and the *Conversazione* was held at the Imperial Institute on Friday last, the 22nd.

The number of persons present was 2,714. All the galleries of the building were open including those containing the Exhibition of British Pottery and Glass, which is being held during the present season. The gardens were specially illuminated by Messrs. Pain. Promenade concerts were given by military and other bands; and the reception by the Chairman and other members of the Council was held in the vestibule of the building.

The District Railway, as on former occasions, allowed the free use of their subway to visitors coming by railway.

Tickets were sold to members of the Society for the use of their friends—an arrangement which has been found very convenient on former occasions, but which is not now permitted when the use of the South Kensington Museum is granted for the purposes of *conversazioni*.

XX.—JOURNAL INDEXES.

In 1892, the 40th volume of the *Journal* was completed. The indexes for the 10 years' volumes—Nos. 31 to 40—have now been amalgamated, and will shortly be issued as the fourth 10-Volume Index to the Society's *Journal*. As soon as the printing is complete, notice will be given in the *Journal*, and members desiring a copy of the index can have it on application. The three 10-volume indexes for the first 30 volumes of the *Journal* are all in print, and can be supplied to any members who require them.

XXI.—OBITUARY.

The losses by death among prominent members of the Society have been less numerous than in some recent years, although several very well-known and active members have passed away. No less than three actual members of the Council have died during their year of office—Sir Philip Cunliffe-Owen, Lord Alfred Churchill, and Mr. Herbert Saunders—and one—Mr. Hawksley—whose term of office on the Council expired two years ago.

Few members of the Society had its interests more closely at heart than Lord Alfred Churchill. He took the warmest interest in its welfare, and a great number of its members, including many of its most active ones, were introduced by him. Sir Philip Cunliffe-Owen was another member to whom the Society owes very much, and whose work, in

very many directions, was closely associated with that of the Society. Mr. Herbert Saunders was elected for the first time on the Council at the last annual meeting. Mr. Hawksley was an old member of the Society, and held office as Vice-President for four years. Among other members whose loss the Society has to deplore, may be mentioned:—Capt. Cameron, the distinguished explorer; Colonel Haywood, the well-known engineer to the City of London; and Mr. Reckenzaun, the distinguished electrician, who had contributed several valuable papers to the Society.

XXII.—NEW COUNCIL.

His Royal Highness, the President, has been graciously pleased to nominate H.R.H. the Duke of York as one of the Vice-Presidents of the Society for the present year. The members will appreciate this proof of the interest which H.R.H. the Prince of Wales takes in the Society, and they will welcome, for his own sake, the addition of the Duke of York's name to the list of Vice-Presidents.

It will be within the recollection of the Members that at a special General Meeting in 1892 power was given to the Council to nominate six additional Vice-Presidents, who should hold office until the end of the present Session, the object being to continue in office until after the close of the Chicago Exhibition, certain members of the Council whose services, as members of the Royal Commission, would be likely to be of value. The six gentlemen who were nominated last year for this purpose were:—Major-General Sir Owen Tudor Burne, K.C.S.I., C.I.E., Mr. R. Brudenell Carter, F.R.C.S., Lord Alfred Churchill, Sir Phillip Cunliffe-Owen, K.C.B., K.C.M.G., C.I.E., Sir Owen Roberts, M.A., D.C.L., F.S.A., and Sir Richard Webster, G.C.M.G., Q.C., M.P.

Lord Alfred Churchill and Sir Philip Cunliffe-Owen died during their year of office, and the other four of necessity retire. In addition to these, the four senior Vice-Presidents retire under the terms of the Bye-laws. They are—Sir Edward Birkbeck, Bart., Prof. James Dewar, M.A., LL.D., F.R.S., Sir Douglas Galton, K.C.B., D.C.L., F.R.S., and General the Right Hon. Sir Henry F. Ponsonby, G.C.B. Another vacancy was caused by the death of Mr. Herbert Saunders. To fill these five vacancies, the Council have nominated the following:—The Earl of Rosebery, K.G., Lord Halsbury, Sir Courtenay Boyle, K.C.B., Sir Richard Webster, G.C.M.G., Q.C., M.P., and W. Anderson, D.C.L., F.R.S. The first

three have not served on the Council previously. Lord Rosebery is an old member of the Society, having been elected in 1876, and the Council feel sure that the members will appreciate the distinction which the addition of the Prime Minister's name to the list of Vice-Presidents will confer upon the Society. Lord Halsbury has been a member for a still longer period, as he joined the Society as far back as 1866. Sir Courtenay Boyle's official position, as the chief permanent official of the Board of Trade, will certainly make him a most suitable, and, the Council hope, useful Vice-President. Mr. Anderson has served on the Council in various capacities for some years; last year he filled the office of Treasurer. The Council are glad to be able to keep the name of Sir Richard Webster—the duties of whose office, as Chairman of the Council, were largely increased by the work of the Chicago Exhibition—on the list of Vice-Presidents.

The four retiring members of the Council are—Sir Edward Braddon, K.C.M.G., Mr. James Dredge, Professor Francis Elgar, LL.D., and Mr. John Fletcher Moulton, Q.C., M.P., F.R.S. To fill these vacancies the Council have nominated Captain Abney, C.B., F.R.S., Mr. John Wolfe Barry, Lord Belhaven, and Mr. Alexander Siemens.

Of these gentlemen, only one, Lord Belhaven, has served previously on the Council, when he was Colonel Hamilton. The other nominees will all be well known to the members, and will, the Council are certain, render good service to the Society in their new capacity.

Sir Owen Roberts's term of office as Vice-President, as above stated, has expired. The Council propose him as one of the Treasurers; as the members are aware, he has already filled the office on previous occasions.

The CHAIRMAN (Sir Henry Doulton) in moving the adoption of the report, said it was a record of the varied and important work which was being carried on, and showed the vitality of the Society, which took the initiative, rather than followed public opinion. The report specially alluded to the Chicago Exhibition. He thought only those members who were closely connected with the Society could realise the amount of work this had entailed, and of the very great services which had been rendered by the Chairman of Council, Sir Richard Webster, who, notwithstanding his varied and obligatory duties, had attended most meetings of the Commission and of the Society's Council besides. At some inconvenience, he had made a visit to Chicago, and their special thanks were

due to him for the valuable services he had rendered. He deplored the loss the Society had sustained by the death of Sir Philip Cunliffe-Owen, who, by his never failing courtesy during his life-long official connection with all the important Exhibitions, had won the esteem of all he had had to deal with. In Lord Alfred Chnrchill they had also lost a member who had always taken the deepest interest in the Society.

Mr. FRANCIS COBB seconded the motion.

Mr. J. L. S. HATTON asked whether any other notice was given to the members, announcing the date of the meeting, besides that which appeared in the Society's *Journal*. He thought that a special letter should be addressed to all the members to inform them of the meeting.

The SECRETARY said that, in accordance with the terms of the Bye-laws, the meeting had been announced by the insertion of a notice in the *Journal* and an advertisement in *The Times*.

Mr. MARTIN WOOD said he hoped the Society would take into consideration the Bye-laws relating to the formation of the Council, and determine whether or not they should be revised. He considered they were antiquated in that respect. He also thought that if the time of meeting were altered to 8 o'clock more members would attend; in this, too, they were bound down by the Bye-laws.

Mr. HATTON wished to inquire whether the lease of the Society's House had nearly run out, and, if so, what steps were being taken with respect to its renewal.

The CHAIRMAN said the Council had had the matter of the expiration of the Society's lease under consideration.

Mr. FRANCIS COBB said the Council had given the matter of the expiration of the lease their careful consideration for the last ten years.

Mr. MARTIN WOOD hoped that something would have been said in the report with regard to the composition for life membership. He thought, if an alteration was made in regard to this, members' names would remain longer on the Society's books, and there would be an increase in the number of life members. He brought this up at the last annual meeting, and had afterwards transmitted a suggestion to the Council, and he trusted that the Council had the subject still before them.

The SECRETARY said this communication had been referred to the Finance Committee, and was still under consideration. He had been instructed to make inquiries and find out what was the practice in kindred societies, in order that the matter might be fully considered.

Mr. HATTON inquired whether any facilities were afforded to the Press to acquire summarised reports of the papers to be read before the Society at their weekly meetings, and if so, whether they could be obtained on application?

Mr. FRANCIS COBB said that every facility was afforded the Press, and condensed reports of the meetings usually appeared in all the principal newspapers.

The SECRETARY said that advance proofs of the papers to be read were given to the newspapers.

Mr. HYDE CLARKE said that members were well aware that the reporters were furnished with copies of the papers read, which appeared in a great many and occasionally in all, of the newspapers. The Society were very much indebted to the Press for the propagation of its work, for after all, the work of the Society was not solely performed by speaking in that room, but by the *Journal* and, perhaps still more, by the daily Press. Year after year the Society's room became the place for the discussion, and the *Journal* the record, of every improvement of public importance. If the Society was to be well governed and to enjoy public confidence, he thought there was no need to make any alteration in the Bye-laws. He felt sure that members by leaving the constitution of the Council in the Council's hands, could rely upon their doing their duty properly.

The adoption of the report having been carried,

The CHAIRMAN moved a vote of thanks to the officers of the Society, which was seconded by Mr. MICHAEL CARTEIGHE, and carried unanimously.

The SECRETARY returned thanks to the Society for once again testifying to their confidence in the officers.

The ballot having remained open for one hour, and the Scrutineers having reported, the CHAIRMAN declared that the following had been elected to fill the several offices. The names in *italics* are those of members who have not, during the past year, filled the office to which they have been elected.

PRESIDENT.

H.R.H. the Prince of Wales, K.G.

VICE-PRESIDENTS.

H.R.H. the Duke of Saxe-Coburg and Gotha, K.G.	Sir Frederick Abel, Bart., K.C.B., D.C.L., D.Sc., F.R.S.
<i>H.R.H. the Duke of York, K.G.</i>	Duke of Abercorn, K.G., C.B.

<i>W. Anderson, D.C.L., F.R.S.</i>	Sir Stuart Knill, Bart., Alderman.
Sir George Birdwood, K.C.I.E., C.S.I., M.D., LL.D.	Sir Frederick Leighton, Bart., P.R.A.
<i>Sir Courtenay Boyle, K.C.B.</i>	Sir Villiers Lister, K.C.M.G.
Sir Frederick Bramwell, Bart., D.C.L., F.R.S.	J. Biddulph Martin.
Michael Carteighe.	William Henry Preece, C.B., F.R.S.
Major-General Sir John Donnelly, K.C.B.	Sir Albert Kaye Rollit, M.P., LL.D.
Sir Henry Doulton.	<i>The Earl of Rosebery, K.G.</i>
<i>Lord Halsbury.</i>	Sir Saul Samuel, K.C.M.G., C.B.
Lord Kelvin, P.R.S.	Sir Richard Webster, G.C.M.G., Q.C., M.P.
Sir Charles Malcolm Kennedy, K.C.M.G., C.B.	

ORDINARY MEMBERS OF COUNCIL.

<i>Captain W. de W. Abney, C.B., F.R.S.</i>	John O'Connor.
<i>John Wolfe Barry.</i>	Florence O'Driscoll, M.P.
<i>Lord Belhaven.</i>	Sir Westby B. Perceval, K.C.M.G.
George Ledgard Bristow.	Prof. William Chandler
Sir George Hayter Chubb.	Roberts-Austen, C.B., F.R.S.
Prof. Clement Le Neve Foster, D.Sc., F.R.S.	<i>Alexander Siemens.</i>
Walter H. Harris.	

TREASURERS.

B. Francis Cobb.
Sir Owen Roberts, M.A., D.C.L., F.S.A.

SECRETARY.

Sir Henry Trueman Wood, M.A.

On the motion of the CHAIRMAN, a vote of thanks was passed to the Scrutineers, which was carried unanimously.

Mr. MICHAEL CARTEIGHE proposed a vote of thanks to the Chairman, who had, he said, identified himself with the work of the Society in a marked degree.

The resolution was seconded by Sir GEORGE BIRDWOOD, and carried.

The CHAIRMAN acknowledged the vote of thanks, and the meeting then adjourned.

Miscellaneous.

AGAVE AMERICANA FIBRE.

A note on extraction of *Agave americana* fibre at Coimbatore, by Mr. Edgar Thurston, Government

Superintendent of the Central Museum, has been published as one of the bulletins of the Department of Land Records and Agriculture, Madras, from which the following particulars are extracted:—

Agave americana grows in all soils (red, black, and gravel) in the Coimbatore district. It is planted extensively as a protective hedge along the Madras Railway line, and flourishes, in the open, freely exposed to the sun, and unsheltered by trees, shrubs, &c. In some places between Coimbatore and Erode, where the agave is overgrown with creepers, the plants are unhealthy; and in other places (e.g., near Tudiyalur), plants which are shaded by tamarind, nim, and other trees, are stunted, while those which grow in the open are rich in leaves and luxuriant in growth. The age of the plants from which the leaves are taken for fibre is six to seven years. The old green leaves falling outwards from the central stem are cut for fibre. The fibre is, as a general rule, extracted immediately the leaves have been cut, or after a lapse of a few hours. Sometimes, however, the leaves are kept for a day or two, and the fibre is extracted when the people have leisure.

The extraction of the fibre is performed by hand, and no machinery is used. The fibre is extracted by two methods, viz., scraping and maceration.

Scraping.—The leaves are cut, the sharp spines removed with a knife, and about six inches cut off from the top of the leaf. The leaf is then split longitudinally into four or five pieces, which are beaten with a wooden mallet and placed on a board 4' x 4' x 3" held firmly by the toes. The pulp is then removed by means of a bamboo scraper, one edge of which is shaped in the form of a blade, and the fibre dried by exposure to the sun. The fibre obtained by this simple process without washing or bleaching is very clean and free from pulp. The staple is not, however, very long. It is made into thread, which is used in weaving grass mats.

Maceration.—As in the previous method of fibre-extraction, the leaves are cut, and the spines removed. The whole leaf is then beaten with a wooden mallet, and thrown in bundles into tanks or wells, in which it is left to macerate for a fortnight to twenty days, or until the pulp is quite decomposed. The bundles are then taken out, dried, and bleached in the sun. The fibre obtained by this process is longer than that obtained by scraping, but is not nearly so clean.

A very large supply of the fibre could be obtained, if a demand of it arose. At present it is sold in the bazaar at the rate of 2 annas per lb., but if a regular trade in it was started, the price would doubtless be reduced.

The mean temperature of Coimbatore is 78°, ranging between a maximum of 97° and a minimum of 64°. The annual rainfall of Coimbatore is about 21 inches, of which half falls during the north-east monsoon (October to December), the remainder being distributed over the other months of the year.

Correspondence.

ETYMOLOGY OF PEWTER.

MR. WALTER SMARTT writes:—Pewter should consist of about 83 parts tin to 17 parts lead. For special purposes, additions are made of small quantities of other metals, including about 5 per cent. of brass. Brass should consist of 2 parts copper to 1 zinc. I am not aware that zinc alone is added; therefore, so little zinc is ever used, that "pewter" appears unlikely to have been derived from "spelter." Baily's dictionary of 1726 says, "Pewter [*Pewter, Du.*], a white mixed metal," from which it appears possible that the metal and the name were introduced here from Holland.

LIQUID FUEL.

With reference to Mr. Stockfleth's remarks, that "the most primitively constructed pulverisator" answered as well as the more complicated kinds, I beg to observe that, in my experience, I have found that considerable economy is effected by employing the most suitable injector or pulveriser, and that the most efficient injector is that which delivers the oil-fuel in a vapourised condition, as in the *Ruby*, which was worked by oil-fuel without coal, for over four months continuously, under steam day and night; and the system was approved by the Committee of Lloyd's, also by the chief engineer-surveyor of the Board of Trade, and several other equally competent experts. This injector is practically noiseless, and the chief engineer-surveyor of Lloyd's and the undersigned were able to converse in the ordinary tones of voice, when seated in front of and close to the boiler, the injector being in full work, and the vessel going at full speed. The great "roar of the blast" has been found to be extremely detrimental, both on vessels in the Caspian and on other boilers, including the locomotives on the Great Eastern line.

Mr. Stockfleth remarks on the use of compressed air, and says that "the results have not materially differed from those obtained with steam." I cannot agree with him, and have found that, by the use of compressed air, complete combustion is not obtainable, but a vast amount of soot is deposited in the boiler tubes; moreover, as there is evidently an excessive amount of air used, and no account is taken of its volume, we need hardly be surprised at the result, but, with superheated steam especially, a considerably different result is obtained.

I cordially agree with Mr. Stockfleth when he says that "it is not probable that compressed air can be produced cheaper than steam direct from the boiler." The arrangement for passing steam through the oil-pipes as a precaution for clearing any obstruction is what I have for the last eight years always adopted; but it was rarely required to be used.

Among the general advantages, Mr. Stockfleth mentions that the fire-bars can be covered over, &c., but I wish to point out that this may be all very well in an externally fired boiler, such as a Belleville or Petersen's water-tube boiler, but with the ordinary internally fired boiler, such as the Marine and Lancashire, it is infinitely better to remove the fire-bars and entirely close the front of the furnace, and so utilise the whole of the surface for absorbing the heat generated; and I am glad to find he is approaching the result that I have attained, and that he states the steam generating power of one ton of "astakti" is equal to more than two tons of coal. Mr. Stockfleth enumerates some of the many advantages with which I concur generally, but to my view he does not give them sufficient prominence, and I wish to point out that on my oil-fuel system, it would be almost, if not quite, impossible for any amount of water—shipped in a heavy sea—to extinguish the fires, as such water could not gain access to the furnaces, which are practically closed up air-tight in the stokehold, at the same time receiving the necessary supply of air through an internal pipe passing down the funnel, thereby supplying heated air to support the combustion, consequently, your readers will not be surprised at the Admiralty staff engineer remarking that in my vessel "the stokehold was so clean a carpet might be laid on the floor."

An eminent naval officer, in discussing the subject with me, recently remarked that the enemy having oil-fuel on their vessels, lasting three times as long as the Britisher's coal supply, would draw them away from their base by feigning flight, and when the Britisher's coal was just about used up, would turn on and capture them.

Now, Mr. Stockfleth's remarks, as to the need of a boiler specially suited to burn oil-fuel, such an one has been invented by a Mr. Petersen, an engineer of considerable practical experience, and it is designated the "compound-tube water-tube boiler." He also invented a compound tube for the ordinary marine boiler, which, while largely augmenting the heating surface, renders them suitable for oil-fuel to the total exclusion of incombustible coal; and while writing on this I particularly wish to call attention to the leading features of this unique water-tube boiler, which surpasses all others of every kind—the excellent and rapid circulation, the ease with which a set of compound tubes can be removed if defective or if requiring to be cleaned, and replaced in a few minutes; all joints are metallic, the cups are shrunk on the upper and lower ends of seven small tubes (from which the term compound-tube is derived), the space occupied, the consumption of fuel, the cost of construction will be reduced to about half that of the ordinary marine boiler of like power, and the weight under steam will be about one-eighth.

As to the question of supply, there can be no doubt but that the demand has only to be made, and the supply will soon be developed; in fact, arrangements are now being made to enable a supply for

five years to be concluded with a very large steamship company. The Committee of Lloyd's having approved of the oil-fuel system, there can no longer any question be raised as to its safety. Finally, it is to be noted that the crude arrangements which were last year in use on the Clyde steamers should not be allowed to influence the minds of people, as, if the perfected system had been employed, a very different result would have been recorded.

EDWIN N. HENWOOD,
Naval Architect and Engineer.

22, Great St. Helens, London.

General Notes.

TOTAL PRODUCTION OF GOLD AND SILVER.—M. Edmond Théry, Director of the *Economiste Européen*, states that the whole production of all the mines in the world, from the discovery of America, in 1493, to the year 1892 inclusive, amounts to 233,950 tons of silver, representing, at the present nominal value of that metal, 51,936,000,000 francs, or £2,077,440,000, and 12,358,932 kilogrammes of gold, representing 42,564,000,000 francs, or £1,702,460,000, making a total of 94,500,000,000 francs, or £3,780,000,000. The total quantity of gold would form a cube of 8.62 metres side, and a base of 74.3 square metres area. With the same base, the 22,280 cubic metres of silver already extracted would form a solid column of 300 metres height, exactly equal to that of the Eiffel Tower.

PETROLEUM IN SUMATRA.—The deposits of petroleum discovered a few years ago in the Province of Lanhkat, in the northern portion of the island of Sumatra, and along the coasts of the Malacca Straits, are being rapidly developed. Concessions have been granted by the Dutch Indian Government to both Dutch and English capitalists, but at present only the Dutchmen have worked their concessions. The area of the lands conceded amounts to 828 square kilometres (318 square miles), and it is believed that this portion of the island is very rich in petroleum. The wells are put down very near to the coast, so that the expense of carriage and shipment are not heavy, and, as the quality of the oil is very good, it is thought Sumatra may, before very long, enter into serious competition with Russia and America, the more so, as this portion of the coast possesses a deep and well-sheltered harbour.

THE COTTON TRADE IN JAPAN.—Cotton spinning has only been carried on in Japan since the year 1848, and that in only a few provinces; but in 1879 the Government ordered from England the most improved machines, and distributed them through certain districts of the empire. It is chiefly since 1882 that new factories have been started; and so great has been their increase that the number of spools, which in 1884 was only 35,000, has now attained the figure of 380,000, while the capital sunk

in the cotton trade amounts to 10,000,000 piastres, and 20,000 hands are employed. As a natural consequence the imports of cotton thread are diminishing yearly. In 1888 the imports amounted to 474,396 piculs, valued at 13,611,000 silver yen; in 1890 they were only 319,083 piculs, valued at 9,928,000 yen; and lastly, in 1891, the value was only 5,589,000 yen. It is confidently expected that in a short time the Japanese will spin sufficient cotton for their own requirements, and will then seek outlets in China and the Corea.

GLASS COLOURING IN GERMANY.—The beautiful colouring of certain varieties of glass now produced in Germany, and which is said to far excel some of the most noted French specimens, is an art practised, by the glassblower at the furnace, by means of an apparatus consisting of a sheet iron cylinder, twenty inches long and eight inches diameter, standing vertically, and having a similar cylinder rivetted across the top. *Kuhlow's German Trade Review* says that in the lower cylinder is an opening into which an iron ladle can pass, and the horizontal cylinder is provided with doors at either end, the one nearest the operator being so arranged that the blow-pipes can be supported when the door is closed in a horizontal split running to its middle, the object to be treated being held inside. While the glassblower is reheating his work for the last time in the furnace, an attendant takes the long-handled iron ladle, which has been heated red hot, shakes into it about a spoonful of a specially prepared chemical mixture, and places the bowl of the ladle quickly in the opening provided for it in the vertical cylinder. The mixture immediately gives off vapour, which rises to the horizontal cylinders, where, meanwhile, the blower has placed his work, supported by the blow-pipe and heated to an even red, turning it rapidly in the vapour. In a short time the object is covered with a changeable lustre, is removed from the pipe and tempered like other ware in an ordinary oven then cut, engraved, painted, or gilded as desired.

ERRATA.—The following corrections to the print of his paper on "Evolution in Decorative Art" have been sent by Mr. Henry Balfour:—

Page.

461.—Col. 2, line 10, for ".....temples!" read "..... temples"!

462.—Fig. 7 should be described as "from a shell pendant, with conventionalised figures of frigate birds, Solomon Islands."

464.—Fig. 10. The right hand figure alone is from Joest's "Tatowiren," the others are from specimens in the Museum at Oxford.

465.—Col. 2, line 8, after "illustration here given," insert "fig. 11." Fig. 11 has been printed sideways, and should be turned round, so that the present right hand side may be at the bottom.

466.—Col. 1, line 3, for "Zûni" read "Zuñi,"

Journal of the Society of Arts.

No. 2,172. VOL. XLII.

FRIDAY, JULY 6, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Chicago Exhibition, 1893.

REPORT ON WOMEN'S WORK, BRITISH SECTION.

The following report of the Ladies' Committee of the British Section has been transmitted to the Royal Commission:—

In October, 1892, at the request of the Royal Commission, of which Sir Richard Webster, Q.C., M.P., was chairman, H.R.H. Princess Christian, of Schleswig Holstein, Princess Helena, of Great Britain and Ireland, accepted the presidency of a Committee of English women to represent, as far as possible, the work of women in England at the World's Fair in Chicago.

A large and representative Committee was formed, and the work of collecting and choosing the exhibits was undertaken by the different vice-presidents of each section of work, with the assistance of their separate sub-committees. Miss Fay Lankester was appointed secretary to the Committee by the Commission. A small Finance Committee, with Sir Douglas Galton as chairman, was appointed by Her Royal Highness.

The Committee was divided into eleven sections, the presidents of each section undertaking to form sub-committees and regulate the collection of exhibits—thus Scotland, Ireland, and Wales were represented. Education, handicrafts, lace, literature, needlework and embroidery, philanthropic work, and nursing, with the Countess of Aberdeen, Lady Aberdare, Mrs. Fawcett, Lady Roberts and Miss Webster, Duchess of Abercorn, Mrs. Gordon, Lady Henry Grosvenor and Lady Amherst, the Baroness Burdett-Coutts and Mrs. Bedford Fenwick, as presidents of the sections, each lady forming an active sub-committee to assist her in her work.

Mrs. Roberts-Austen kindly undertook the decoration of the vestibule, which was most

beautiful, with panels on one side, by Mrs. Swynnerton, representing Nursing, in three groups, and on the other side by Mrs. Lee Merrett, representing Kindergarten; a group of women embroidering and women receiving degrees at the London University.

Miss Roper and Miss Halle furnished bas-reliefs, which were placed over the entrance.

Mrs. Roberts-Austen also sent out a few selected paintings by eminent women artists.

Miss Helen Blackburn kindly undertook to lend a collection of portraits of eminent women. They were arranged in periods—in Mediæval period, in Tudor period, Civil Wars, early half of 18th century, pioneers in Philanthropy and General Advancement of Women, pioneers in Education; Central Group, Science, History, &c.; General Literature, Poetry, Fiction, Drama and Music, Art; in all, nigh upon 200 portraits.

Mrs. Fawcett, besides being president of the Education Committee, was kind enough to write the report for the catalogue to the Women's Building, and this she did in the most able manner, explaining the objects and aims of the Women's Committee.

Some of the vice-presidents also wrote short prefaces on their own particular work in the catalogue: Mrs. Fawcett, for the Education Committee; Mrs. Bruce Clarke, for the Lace Committee.

Lady Priestley contributed a paper on "Hygiene in the Home" to the Congress, and Miss Blackburn undertook to provide one on "Patents taken by Women."

Thus about a hundred educated women were energetically interested in the active occupation of forming a suitable representative exhibition of the work of their fellow countrywomen. The expenses of the collections, show cases, freight, and insurance were heavy, but the Commissioners most generously undertook the expenses of freightage, insurance, and return of goods.

Her Royal Highness attended all the meetings personally, and was actively interested in the promotion of the work. The Committees have every reason to be congratulated on the speedy, economical, and business-like way with which their work was accomplished, the Englishwomen's Section being the only one that was ready on May 1st, when the Exhibition opened, mainly owing to the energy of Mrs. Cope, the lady sent out in charge of the exhibits. As the ladies did most of the work themselves, there was very little expense attached to the undertaking, except the most

absolutely necessary expenditure. Mrs. Cope was sent from England in charge of a certain number of exhibits—royal exhibits, needle-work, handicraft, lace, Welsh, and Indian work sub-sections.

Her Majesty the Queen and the Royal Family of England sent several paintings and work executed by themselves; also other exhibits:—

1. Six original sketches from nature in one frame, by H.M. the Queen.

2. Copy in water colours from an oil painting, size of life, of H.M. the Queen's Munshi and Indian Secretary, Ab-dul-Karim, 1892, by H.M. the Queen.

3. Two pictures in oil by H.R.H. the Princess Christian of Schleswig Holstein.

4. Study from nature in water colours, by H.R.H. Princess Louise.

5. A picture by H.R.H. Princess Beatrice (Princess Henry of Battenburg).

Two napkins made from flax spun by H.M. the Queen.

A hat plaited by H.M. the Queen and given to her grand-daughter Princess Victoria of Schleswig Holstein.

Corner chair of carved oak and cut and embossed cowhide, H.R.H. the Princess of Wales.

Embroidery on linen: knitted jersey—H.R.H. Princess Helena (Princess Christian of Schleswig Holstein).

Music-stool of carved oak and cut and embossed cowhide, by H.R.H. Princess Victoria of Wales.

Stool of carved oak and cut and embossed cowhide, H.R.H. Princess Maude of Wales.

These Royal exhibits were received with especial interest in America.

The sales of work were not large, partly on account of the heavy duty to be paid on English goods and partly on account of the restriction that visitors could not take away purchases from the building until after the closing of the Exhibition.

The British Nursing Section received particular distinction in the way of medals and awards.

The collection of lace sent by the Duchess of Abercorn was particularly beautiful, as were the exhibits and specimens of lace sent by the Countess of Aberdeen.

The Scottish industries have profited by sending exhibits to the Exposition, as many sales took place in the way of Harris tweeds, Shetland shawls, hand-knitted stockings and gloves.

The cottage industries at the Welsh Section attracted considerable attention, more especially the hand-loom weaving, where 928 yards

of flannel was woven during the Exhibition by a young Welsh woman in national costume, sent out for the purpose. The spinning wheels both of North and South Wales were very interesting and "Welsh sections" was always popular amongst the visitors.

Two lady custodians, Mrs. Bond, an English lady residing in Chicago, and Mrs. Cope, sent out from England, were actively employed during the whole time of the Exhibition, and and votes of thanks were sent to England by the Board of Lady Managers on account of the active services rendered by these ladies, and letters expressive of warm appreciation of British women's exhibits have been received from Chicago.

Three lady judges were appointed by the Committee at the request of the Board of Lady Managers, viz., Miss Kenealy, Nursing, &c.; Mrs. McAllum, Philanthropic Work; Mrs. Crawford, Art and Handicraft.

Several members of the Ladies' Committee visited Chicago during the Exhibition. Mrs. Bedford Fenwick made two journeys to instal the nursing exhibits, and obtained medals for the nursing appliances. Miss de Pledge also attended and read papers. Mrs. Roberts-Austen personally superintended the decoration of the vestibule with panels. Mr. Osborne also went on account of the Baroness Burdett-Coutts.

Notices of the numerous medals and awards which have been gained by British women have been sent to the president of each section; they are too numerous to mention in this report. An official list can be seen at the offices of the Women's Work, 53, Berners-street, W., or at the Society of Arts.

The thanks of the Ladies' Committee are due to Sir Frederick Abel in lending space at the Imperial Institute for the packing of exhibits and the reception on their return to England; and to Sir Somers Vine and the officers of the institute for their courtesy in assisting the Ladies' Committee in every possible way.

The exhibits not sold have been returned, with very little damage.

SCOTLAND.

President.—Countess of Aberdeen, in conjunction with the Scottish Home Industries Association.
Hon. Secretaries.—Miss Munro Ferguson and Miss Meta Donald.

IRELAND.

President.—Countess of Aberdeen, in conjunction with the Irish Industries Association.

WALES.

President.—Lady Aberdare. *Hon. Secretary.*—Miss Adeane.

EDUCATION.

President.—Mrs. Fawcett. Miss Buss, Miss Julia Cock, M.D., Miss Davenport Hill, Miss Gurney, Miss Tod (Belfast), Miss Kingsley, Miss F. Stevenson (Edinburgh), and Miss L. Stevenson.

HANDICRAFTS.

Presidents.—Lady Roberts and Miss Webster. Mrs. Jack Johnson, Miss H. Blackburn, and Miss C. Holden (hon. sec.).

LACE.

President.—Duchess of Abercorn. Lady Clinton, Lady Ernestine Edgcombe, Lady Susan Fortescue, Lady Idlesleigh, Lady Kenmare, Lady Kennaway, Lady Morley, Hon. Mrs. Marker, Hon. Mrs. Peek, Mrs. Bruce Clarke, Mrs. Alfred Morrison, Mrs. Reeve, and Miss Constance Hargrove (hon. sec.).

LITERATURE.

President.—Mrs. Gordon. Mrs. Humphrey Ward, Mrs. Clifford, Miss Gayford (hon. sec.), Mrs. Green, and Miss Kingsley.

NEEDLEWORK.

Presidents.—Lady Henry Grosvenor and Lady Amherst of Hackney.

NURSING.

President.—Mrs. Bedford Fenwick. Lady Jeune; Lady Priestley; Miss Emily Shaw-Lefevre; Miss Isla Stewart, Matron St. Bartholomew's Hospital; Miss K. Hendie Close, Lady Superintendent for Sick Children, Great Ormond-street; Miss de Pledge, Matron Chelsea Infirmary; Mrs. Cheadle, late Inspector Queen's Nurses; Miss S. Cartwright, Gordon House Home Hospital; Mrs. Walter Lakin, Miss Edith Kirwas-Ward; Miss Annesley Kenealy; and Mrs. Holmes Spicer, (hon. sec.).

PHILANTHROPY.

President.—Baroness Burdett-Coutts. Countess of Harrowby, Mrs. Boyd Carpenter, Miss Mary Steer, Mrs. Holmes White, and Miss Ellen E. White.

(Signed),

HELENA,

Princess of Great Britain and Ireland,
Princess Christian of Schleswig Holstein,

FAY LANKESTER,

Secretary.

In moving the report, at a meeting of the committee held at 53, Berners-street, on the 26th May, H.R.H. PRINCESS CHRISTIAN said:—

I do not desire to occupy your time with any unnecessary or lengthened speech, but I should be sorry if this, our last meeting, terminated without my expressing, as your president, a sense of my appreciation of the way in which the work of the Ladies' Committee has been performed by the ladies of the General Committee, the members of the sub-committees and their respective honorary secretaries. The idea of a section devoted especially to women's work was, at any rate, so far as International Exhibitions are concerned, new, and I feel that, in many respects, you were called upon to arrange for and make a selection of exhibits, as to which very little guidance could be derived from past experience. I believe, from the information which I have received, that the exhibits of women's work sent by Great Britain were highly creditable to the nation, and no doubt in any future Exhibition, should a similar department or section be created, the experience which you have gained will be of great service to others. I feel that in the way in which your work has been performed you have shown great capacity for grasping the novel, and by no means easy, problems which had to be solved. It will, I think, be scarcely fitting that I, as your president, should propose, or that you should pass any vote of thanks to yourselves, but I trust that this expression of my appreciation of, and gratitude for, the ready way in which you have responded to my invitation will not be unwelcome to you.

Proceedings of the Society.

FOREIGN AND COLONIAL SECTION.

Tuesday, May 29, 1894; Sir CHARLES M. KENNEDY, K.C.M.G., C.B., in the chair.

The paper read was—

BLACK AND WHITE IN AFRIKANDERLAND.

By W. A. WILLS.

To some extent, though not perhaps to a very large one, the people of this country have now become acquainted with the vast commercial resources of South Africa; but I venture to say that they are not nearly so well informed upon the subject of the new and vigorous nationalities now growing up into manhood there, nor upon the interesting racial problems of that country. South Africa—by which, roughly, one means that portion of the continent lying south of the Kunene and the Zambezi rivers—covers an approximate area of a million and a-half square miles. Of that enormous area, more than half is British, viz.,

the Cape Colony, Natal, Bechuanaland, and the huge territories administered by the British South Africa Company. The non-British area comprises the two Dutch Republics, in one of which, however, the Transvaal, the British element is predominant. On the east coast there is the province of the Mozambique, theoretically, Portuguese, but subsisting upon British trade, and developed by British capital; and, finally, there is the German protectorate in South-West Africa, now being opened up by an Anglo-German Company, in which the necessary capital has been found by a group of British merchants. So that in South Africa British interests, political or commercial, are very large and important. Now, everyone knows that this great area is richer than any other portion of the earth's crust in the precious minerals. The Witwatersrand gold-fields, covering an insignificant strip of country some 40 miles long, are, though still in their infancy, producing more gold than the whole of Australasia or the whole of the United States. They are now contributing about a fourth of the world's output of gold, and, in five years' time, will almost certainly have doubled their present rate of production. Similarly, you are all aware that the Kimberley diamond fields are producing about seven-eighths of the world's output. Again, most people know that a very large portion of South Africa (as I have defined its limits)—probably quite two-thirds—is endowed with an agreeable, healthful, and temperate climate, entirely suited to European constitutions: that is, admirably adapted to the growth of cereals and fruits; and that upon its vast plains are nourished immense flocks of well grown horses, sheep, and cattle. Almost in every way the country is self-supporting, so far as its inherent resources are concerned. What, however, does not appear to be fully realised in this country is, that this vast country—larger than British India—provides a home for a white population not much larger than that which is huddled together in the city of Glasgow. Population statistics relating to South Africa are necessarily somewhat vague and unreliable, but it may be taken for granted that there are not more than 750,000 whites spread over the whole of South Africa. Of these, perhaps, some two-thirds are of so-called "Dutch" descent, the rest are mostly of English race; but it should also be recorded that South African commerce owes not a little to the enterprise and industry of the German colonists, of whom there are a good many dwell-

ing within her borders. There, are, too a few Portuguese on the east coast, but the least said about them the better; their sole mission appears to be to retard the progress of any country over which their ægis has been extended, and it is a thousand pities that the fine natural harbours of Delagoa and Beira, and the great inland waterway of the Zambesi river, lie within the Portuguese boundaries. South Africa may be split up into two great divisions, in one of which there is a considerable white population, and in the other the black element is numerically predominant. Practically speaking, White South Africa consists of the Cape Colony, the Transvaal, the Free State, and Natal; the rest of the country, Rhodesia, Mozambique, and South-West Africa, forms the Black area. For instance, the enormous territory named after Mr. Rhodes, covering some half a million square miles, is populated only by some 3,000 whites; in other words, there are 170 square miles of territory to each white inhabitant, which accounts for the liberality of the Chartered Company in the matter of farms and land grants. In German South-West Africa—covering 322,000 square miles—there are not more than 1,000 whites in all, and probably not more than that number of whites in the Portuguese possessions lying south of the Zambesi.

Fully half of South Africa is included in the black area, and that which most strikes the observer of South African affairs is the enormous industrial results which have been obtained with such a scanty motive force in the shape of white population. Seeing the suitability of climate to the European races, and the splendid and comparatively virgin natural resources of the country, I venture to submit that South Africa, as a field for emigration, offers rare attractions to the overcrowded, over-worked, under-fed, and under-paid population of this country; and I think, also, that it should be made generally known that, though the distance from London or Liverpool, and Cape Town or Durban, is considerable, the steamship fares are by no means beyond the reach of the mechanic and the agricultural labourer, ranging, as they do, from ten guineas, or, where a nomination from a colonist can be obtained, from four guineas. South Africa is (for the matter of that, like all new colonies) emphatically a poor man's country, where, though living is not cheap, wages are good, and work is not difficult to obtain.

I must, however, concentrate myself upon the main theme. The map of South Africa is mainly coloured with good, wholesome British red, thanks largely to Mr. Cecil Rhodes, who is, as you all know, Premier of the Cape Colony, and the moving spirit in the chief territorial and industrial organisations of South Africa. But the country is dominated by a mixed European race, which in process of time will no doubt become fused like the American. The Afrikaner nationality consists of three main component parts. Of these, two—the French and the Dutch—have become intimately commingled; and though they are collectively called “Dutch,” the names of very many of the colonial families bear evidence of their Huguenot origin. The French language has quite died out, and the combined nationality speaks a barbarous *patois* that is certainly not Dutch, as the people of Holland speak it, though descended from that language. The origin of this *patois*, or pigeon Dutch, is accounted for by the fact that for some considerable time the Huguenot settlers spoke their own language, but this was suppressed by proclamation, and the forcible imposition of an alien tongue upon the French settlers brought about its own Nemesis in the form of the abominable jargon which passes for Dutch from the Cape to the Zambesi.

Perhaps I had better recapitulate, as briefly as possible, the main incidents of South African history since the discovery of the country, which, as every schoolboy knows, was made by the Portuguese. It was in 1486, six years before Columbus started on his first voyage across the Atlantic, that Bartholomew Diaz landed on the eastern shores of the Cape, which he first called the Cabo Tormentoso—the Cape of Storms—but which, in anticipation of the discovery of the route to India, he subsequently re-designated the Cape of Good Hope. It was again visited by another famous Portuguese navigator, Vasco da Gama, in 1497. Da Gama touched at Mossel Bay, Natal, Mozambique, and Melinda, and finally reached India, after a voyage of eleven months. For more than a century it was occasionally visited, chiefly for fresh water, by Portuguese and English ships trading with the East, but no settlement was made in the country. About the year 1600 the various private companies in Holland trading with the East were federated into a sovereign concern, similar to the chartered corporations of the present day. This was the Netherlands East India Company, which was the pioneer of civilisation in

Southern Africa. The Dutch East India Company, in 1651, sent out an expedition of three ships, commanded by Jan Antony van Riebeeck. Van Riebeeck found the country round Cape Town inhabited by the Hottentots, who called themselves “Khoi-Khoi.” The name signifies “men of men,” and is rather an amusing designation, seeing that the Hottentot is one of the most diminutive and ill-favoured of the races of mankind. Until 1657 the Dutch settlers dwelt within the walls of the fort at Cape Town, but after that year a few were permitted to settle in the neighbourhood of what is now Rondebosch. This was the origin of the Boer or “Burgher” population, which in 1670 had increased to about 90 men of different nationalities—Germans, Danes, Portuguese, Flemish, and Dutch. The little colony grew very slowly—hardly at all, in fact—until in 1679, Simon Van de Stell being governor, arrangements were made by which 50 mechanics and farmers, and a number of young women from the orphan institutions of Amsterdam and Rotterdam, were sent out to join their countrymen at the Cape of Good Hope. So much for the Dutch ancestry of the Cape colonists. About five years afterwards, 300 Protestant Huguenots, who had been driven out of France upon the revocation (by Louis XIV.) of the Edict of Nantes, were offered a home in, and a free passage to, the Cape by the Dutch East India Company. These men, women, and children arrived during 1688-9. The public records still contain a register of their names, which include those of Du Plessis, De Villiers, Du Toit, Malan, Marais, Retief, Joubert, Le Roux, and numbers of other Gallic surnames which are to-day so common throughout South Africa. They gave to their farms such picturesque titles as Paris, La Motte, Cabrier, and Normandy, and introduced the culture of the vine, and the making of wine, for which the climate and soil of parts of Western Province are probably superior to any in the world. Between 1709-24 the use of the French language was suppressed by proclamation, and half a century after their arrival, the Huguenots had merged into the older colonists, and become a Dutch-speaking people. They have, however, left indelible traces of their national characteristics, not only in the systems of agriculture and horticulture, but in their habits of life, notably the custom of family worship, the regulation of the most ordinary affairs of life by reference to Biblical precepts, and the liberal employment of Scriptural phraseology,

which is still characteristic of the simple Boer. There is no time to-night to trace the slow gradations by which the tiny settlement of 1,700 developed into the great colonial nationalities which to-day occupy the vast plains and highlands of South Africa. On September 6th, 1795, Cape Town was seized by a squadron of British warships, and a large body of troops commanded and was held until 1803, when it was restored to Holland. Three years later war again broke out between England and France, and the Cape, being important as a naval and military station, was recaptured by Sir David Baird, and has remained British ever since, being formally ceded by the King of the Netherlands in 1815. At that date the European population numbered 26,720; these, in 1820, were supplemented by some 5,000 or 6,000 emigrants sent out by the British Government.

The first Governor-General of the Cape was the Earl of Caledon, who ruled from 1807 to 1811; he was succeeded by Sir John Cradock, 1812, and by Lord Charles Somerset, in 1814. Even at this early period South Africa began to assert herself as the grave of gubernatorial reputations. Lord Charles was of an arbitrary and despotic disposition, and the unpopularity of his government led to the appointment of a Royal Commission of Inquiry. He was invited to come home, ostensibly to rebut some of the charges made against him, but, in reality, to pave the way for his retirement, which took place shortly afterwards. About this time the colonists began to be seriously dissatisfied with the manner and methods of the officials sent out to administer the government by the mother country. This feeling has recurred at frequent enough intervals until the present day, and is not by any means confined to the Dutch section of the population; and, beyond a doubt, this dissatisfaction has been, on far too many occasions, based upon very real and legitimate grievances.

In 1834, the colony was suddenly invaded by 10,000 Kaffirs, chiefly Gcalekas, and in less than a week fifty of the farmers, who had had no warning of the invasion, were massacred and their farms sacked. The Governor, aided by the colonists and a small body of Imperial troops, succeeded, however, in expelling the invasion, and in subduing the Kaffirs. In one way or another the then Secretary of State, Lord Glenelg, imbibed the idea that the invasion by the Kaffirs was a natural reaction against the white man's encroachments and repressions, and insisted

upon the relinquishment of the territory of the defeated tribes. The colonists keenly felt the aspersions unjustly cast upon their character, and in 1835, and for a few years onwards, the dissatisfaction of the Dutch colonists resulted in a succession of more or less organised treks from the Cape Colony towards the north and north-east. Beyond the Vaal River the advanced parties were surprised and massacred by Zulus of the Matabeli tribe under Umsiligazi, who were, however, ultimately beaten by the Boers and driven, after a series of desperate engagements, across the Limpopo. In 1837 the Boers were joined by Mr. Peter Retief, who was held in high esteem among them. He organised a simple form of government, based upon the old regulations in force under the Batavian Republic in the colony. They then went on to Natal to negotiate for a session of land from the Zulu King, Dingaan, who, however, treacherously murdered the whole party while witnessing, unarmed, a Zulu sham fight. The death of their countryman was signally avenged by a "commando" of Boers led by Mr. Andries Pretorius, who, on Sunday, December 16th, 1838—a day still commemorated as "Dingaan's Day"—utterly routed an army of 10,000 Zulus, and entirely broke up, for the time, the Zulu power. The Boers only numbered 400 men, and this memorable exploit is only paralleled by the campaign conducted against the Matabeli by the Chartered Company's forces in the late war. Some British troops had been sent to Durban to assist the whites, but on the defeat of Dingaan were withdrawn. This step was regarded as an abandonment of the territory, and in 1839 the Boers hoisted the colours of what they termed "the Republic of Natalia." They laid out the town of Pietermaritzburg as a capital, established a Volksraad, or elective legislative body, and a magisterial system.

In 1842 the Natalians dispatched a commando, or levy of burgher forces, against a native chief upon the Pondo border. The British Government, fearing difficulties with the aboriginal populations, sent Captain Smith with two hundred men to resume possession of the country. The Boers were too strong for him at first, but further support was sent, and on May 12th, 1843—barely fifty years ago—Natal, then a mere wilderness, now a prosperous dependency, was proclaimed a British colony. But the measures of the British Government relative to the apportionment of land and the location of natives soon

gave rise to great dissatisfaction, which was not removed by the fact that the Governor of the Cape Colony, Sir Henry Pottinger, declined to receive and discuss matters with Mr. Andries Pretorius, who was commissioned by the Boers to lay their case before him. These difficulties with the British Government in Natal again drove many of the Boers across the Drakensburg into the territory now forming the Orange Free State. Here they again established a rude form of government of their own, with Commandant Pretorius as President, and when, in 1848, the country was declared British by proclamation, politely escorted the British Resident and officials to the Orange River, and declared their independence. They were, however, at once attacked by Sir Harry Smith with a military force. Pretorius was declared a rebel, and fled across the Vaal River, where he became Commandant-General of the new Republic (now the Transvaal Republic) founded there. History, however, sometimes anticipates itself. We grew tired of the Orange State; discovered that no particular British interests were to be served by remaining there, and so forth; and formally, in 1854, ceded the country, a magnificent pastoral and wheat-growing area, half of it underlaid with coal measures, and containing valuable diamond deposits, to the Free State Boers, who have on the whole been very good friends to us and excellent neighbours ever since.

Meanwhile, in 1849, the Home Government endeavoured to convert the Cape into a penal settlement for English convicts. Naturally this was bitterly resented by the colonists, who immediately proceeded to boycott the Government, and prolonged the struggle for fully six months, when the noxious order was wisely rescinded. In 1853 representative government was granted, and the first Parliament was formally opened by Governor Darling in the next year, when Sir George Grey, now in this country, was appointed Governor and High Commissioner, one of the strongest and wisest who ever represented the Home Government at the Cape. It was he who organised a police force for the protection of the frontier. The first railway line was commenced, telegraphs introduced, and Crown lands surveyed and thrown open during his term of office. He was also the first to give form and expression to the idea of a federation of all the South African Colonies and States.

About this time the Anglo-German legion (disbanded after the Crimea), and a body of

agricultural labourers, were introduced and settled in the neighbourhood of the Buffalo river, Sir Charles Mills, the present Agent-General of the Cape in London, being one of the British Commissioners in the newly-settled districts, where he rendered distinguished services to the colony. In 1871 we annexed the newly discovered diamond fields at Kimberley, which were claimed by the Orange Free State. Through the friendly mediation of Sir Donald Currie, M.P., however, the matter was satisfactorily arranged by our paying an indemnity of £90,000, in return for which we acquired a mineral area which represents to-day a market value of several hundred times that amount. In 1874, affairs in general throughout South Africa being in a very disturbed condition, Lord Carnarvon, who was then Secretary of State for the Colonies, somewhat inopportunistically took steps to bring about a federation, such as he had already assisted in bringing into operation in the Canadian Dominion. Mr. J. A. Froude, the historian, was sent out as Lord Carnarvon's representative to endeavour to bring this matter to a head. The Molteno Ministry, however, somewhat unwisely took exception to what they regarded as the "unconstitutional and sudden manner in which the proposals had been made," and the matter dropped. In 1876 the war with Sekukuni, who was supposed to be in alliance with the Zulu King, Cetewayo, gave rise to the wide-spread feeling of alarm lest there should be a general rising among the natives of South Africa. The Transvaal Boers were unable to crush Sekukuni, and in the interests of the general peace of South Africa the Transvaal was, in the early part of 1877, annexed by Sir Theophilus Shepstone. The president and executive, however, formally protested against the annexation.

In 1879 the Zulu war broke out, and it was only at a great cost of life and treasure that the Zulu military power was broken. Then, in 1880, the Transvaal burghers re-proclaimed their independence, supporting it by taking up arms. Disasters and humiliations, culminating in the fight at Majuba Mountain, were followed by the retrocession of the richest portion of South Africa under a nominal British suzerainty, and even that relinquished in 1884. In that same year we nearly had trouble again with the Boers, who proclaimed jurisdiction over a portion of our Bechuanaland Protectorate. This resulted in the Warren expedition, by which our authority was somewhat expensively, but fortunately, bloodlessly, asserted.

This is a very brief outline of the march of

events in South Africa up to 1890. Should anyone be inclined to pursue the subject in greater detail I would refer them to Noble's "Handbook of South Africa," and to Theal's admirable "History of South Africa," to which works I am largely indebted for the foregoing facts.

The most recent epoch of South African history is not the least interesting, covering as it does the acquisition of the immense Zambesian Hinterlands, which, including the Bechuanaland Protectorate (over which the Chartered Company has now acquired the mineral rights) covers the prodigious area of 1,136,000 square miles.

The inception of this great idea—that of acquiring the back country in British interests—cannot be wholly attributed to Mr. Rhodes, but it cannot be denied that its rapid and complete realisation has been chiefly due to the vigour with which the scheme was handled by that statesman, and to the enormous financial and political resources which he was able to bring to bear upon it. The occupation of Mashonaland was effected in 1890, and up to the middle of last year, the opening up of the country and the development of its mineral resources were proceeding at a most satisfactory rate. Unfortunately, however, the paramount chief of that portion of South Central Africa, the late Lobengula, was induced by his younger warriors to try conclusions with the newcomers in his dominions. The result is still fresh in our memory. A handful of raw civilians, "mostly boys," as the Matabeli used to say, completely broke up within a couple of months the last great Zulu military power which threatened the peace of South Africa. Though the defeat of Lobengula was effected with a minimum of expenditure of life and treasure, we shall not readily forget that it cost us the lives of Major Wilson and the 33 gallant men who stood by him to the last on the banks of the Shangani. You will be glad to hear that a fitting memorial, in the shape of a hospital at Buluwayo, is to perpetuate the memory of those gallant men, and I hope all South Africans will send a subscription to the London committee, which is headed by the Dukes of Abercorn and Fife. The lesson taught by the conquest of Lobengula was not lost upon the other native tribes of South Africa, and paved the way for the peaceful annexation of Pondoland, which took place a month or two afterwards.

Generally speaking, the outlook in South Africa now is a very bright one. There is no

present danger of any further trouble with the native races. The chief question that remains is whether great European peoples which dwell side by side in South Africa will pull together. After the conclusion of a humiliating war with the Transvaal Boers, it was generally feared that the bitter feelings aroused would not die away within the present generation. The Boer looked upon the Englishman with hatred as an oppressor and a bully, who had yielded even before he was properly thrashed, and the English throughout South Africa felt themselves disgraced by the surrender of the Home Government, and, naturally, did not feel too amiably disposed towards the farmers across the Vaal who had inflicted such a severe defeat upon our troops. It is, decidedly, too much to say that those feelings are wholly obliterated, even now. Among the Boers of the Transvaal there are many in whom the old animosity still remains—it is idle to blink the fact. But, generally, much has been done to bring about brotherly feelings of confidence and goodwill, and the credit of that more desirable state of things must be awarded to the statesmanlike efforts of Mr. Rhodes, at the head of the English population, and Mr. Hofmeyr, the guiding spirit of that formidable political organisation known as the Afrikaner Bond.

In the Cape Colony, where the Dutch or Franco-Dutch have long rubbed shoulders and intermarried with the English, the two great Teutonic races have made up their minds like sensible folks to stand or fall together, and I do not think that either Australia or Canada can boast more loyal subjects than the farmers of the Cape Colony who form the Afrikaner Bond. That is not very surprising. The "Dutch" colonists of the Cape of Good Hope are not strong enough to stand alone, numbering as they do under 400,000 persons, in the midst of a seething native population of nearly 1,250,000. They have absolutely no community of sentiment with the Dutch or French from whom they are so largely descended, and their natural friends and allies are the English, whose language they usually speak in addition to their own, with whom they are closely connected by family ties, and by whose side they fought many a hard battle against the native races. Every year brings down yet another of the old race barriers, and for every one youth bearing a Dutch or French name who is sent to the universities of Holland, I venture to say there are ten, or perhaps a great many more, to be found at Oxford and Cambridge, or at London and Edinburgh.

At the same time, the Cape colonists—the English equally with the Dutch—are naturally bent upon managing their own internal affairs. They deeply resent, for instance, the meddling of home officials who have no knowledge of local conditions or local resources and needs; the interference—the most dangerous interference—for instance, with their dealings with natives. And, in fact, so many great mistakes have been made by the Home Government in South Africa that this feeling is natural enough. But whatever alarmist newspapers may say, there is amongst the Cape colonists no thought of separation. The English in South Africa are intensely proud of the mother country, and are, indeed, loyal with an intensity of which stay-at-home Britons can form but vague ideas.

In the Cape Colony the white races represent one-fourth, and the coloured races the remaining three-fourths of the whole population. Speaking roughly, the eastern portion of the Cape is a black area. In the Transkei, for instance, 49-50ths of the population are coloured, while, in Pondoland (recently annexed) there are 200,000 natives and only 100 whites. Nearly one-half of the population is engaged in the agricultural or pastoral industries, but a considerable number is also employed in mining operations. Exceedingly interesting statistics are afforded by the late census returns, from which it appears that, of the whole white population of the Cape Colony of 376,000 souls, nearly 40,000 were born in the British islands. About 6,500 of the colonists were of German birth, the Scots and Germans being about equal in number. Quite a considerable number of the colonists—nearly 1,000—were born in America, and nearly 400 in Australia. South Africa is frequently called the country of young men, in which connection it may be noted that there were, at the time of the last census, only 13 Europeans who had reached the age of 90, while nearly half the population was under 15 years of age.

As things are to-day, the Cape—the mother of the South African States and Colonies—is far more important, politically and industrially, than any of her children, and, further, Mr. Rhodes (I must apologise for so often referring to him, but he has a finger in all the important Afrikaner pies) has stated, in his confident way, that Cape Town is to be the capital of the South African Confederation, which is looming large upon the political horizon. Cape Town, of course, has an important geo-

graphical advantage, in that it is the nearest to England of the South African seaports connected by railroad with the interior. Then, also, Cape Town has a special commercial importance, as the terminus of the great inland railway system, as the financial and commercial centre of the chief farming colony, and as a seat of government. But I cannot help thinking that, as an active centre of business, Johannesburg will shortly run Cape Town very close. By "shortly," I mean—to be explicit—when it is connected with Durban and Delagoa Bay, to say nothing of the Zoutpansberg districts, by the railroads now well under way; when the gold output has reached the rate of £10,000,000 per annum; when the agricultural and pastoral interests of the Republic receive as much attention as they do in the Cape Colony; and, finally, when the town of Johannesburg contains 200,000 inhabitants of the "uitlander" class. All these things will infallibly come to pass within ten years, many of them, probably, in five; and then I quite fail to see how Cape Town will be able to maintain her supremacy as the chief city of South Africa. Nothing, it seems to me, can prevent the Transvaal from taking premier place among South African areas, and that within a very few years. It has at present a European population of probably some 200,000 whites and about 630,000 natives, covering an area as large as France.

The Boers of the Transvaal, though a fine race in their way, have about as many, or as few, points in common with the Boers of the Cape Colony as a private soldier has with a field marshal. In the Cape the Dutch have all the facilities for education which are open to the English, and are, quite as often as the Englishmen, of high culture and of liberal views. For instance, it may be doubted whether there is a more liberal-minded man in South Africa than Mr. Holmeyr, the leader of the Afrikaner party, who is in his way a sort of South African Bismarck-cum-Parnell. But the rough frontier farmers of the Transvaal, without education, even ignorant of civilisation as we spell the word over here, belong to quite another order. They are, in fact, on the intellectual level of peasant classes all over the world. At the same time, it must be conceded that among the leaders there are many of marked ability, notably Paul Kruger, the President of the Republic, who is a man of the greatest force of character, and who has a rough-hewn notion of diplomacy which would not shame a European statesman.

It is interesting to speculate to what heights of statesmanship President Kruger might have risen with the advantages of a good education. His story is in its way full of incident and interest. He was born in the Northern Frontier of the Cape Colony in 1825, and his early training consisted of the usual round of farm duties, varied with occasional visits to the hunting-veld, and frequent fights with the natives on the border. When a lad of ten years old, his father, obeying the racial impulse of expansion, crossed the Vaal River, and assisted to found the infant Republic of which his son ultimately became President. Through the succession of engagements, which resulted in driving Umsiligazi and the Matebeli nation north of the Limpopo, young Kruger accompanied his father. As a lad of twelve years old he was in the laager at the battle of Vechtkop, when the Matabeli, after attacking the Boers repeatedly and with the most desperate courage, were utterly broken. As Kruger grew up he obtained various minor posts under the Government, and in 1862 became Commandant-General, and a member of the Executive Council. After the fatal day of Majuba, he became one of the governing triumvirate, and was shortly afterwards elected to the Presidency. It is chiefly owing to his determined character that the present paradoxical political situation in the Transvaal still obtains. There are in that country actually more English than Dutch, yet the former have no votes at general elections, no voice in the administration of the country, no share in regulating the expenditure of the State revenues, which practically they alone provide. It is they who have built up the State from an insignificant and insolvent Republic into its present powerful political and financial position; who have developed the industries of the country; who have filled the State treasury to overflowing. Sooner or later the artificial barriers which hold back the new element must give way, and when they do, the present constitution must inevitably collapse like a house of cards. The uitlanders—the new comers—have hitherto been entirely absorbed in money-making, but as time goes on they will infallibly assert themselves in political matters. They only demand a fair share in the government of the country in which they are the majority, with nearly all the wealth and nearly all the brains, and that share they will soon have.

Yes, the days of the Boer taskmasters are numbered, and there are many signs of an

impending change. You will remember that it was trouble with a contumacious chief (Sekukuni) which brought about the annexation of the Transvaal. Indeed, the natives have been at the bottom of every row in South Africa since the days of Bartholomew Dias. There it is not *cherchez la femme*, but “look for the native.” It is a similar position which is now ruffling the Pretoria dovescotes. Some stiff-necked chief in the Northern Transvaal has, so it is said, refused to pay the local variety of income tax known as the hut tax. So a “commando” is to be sent into the field in the capacity of an armed tax collector. The Boers, they say, are exceedingly unwilling to go on military service themselves; but their discontent is as nothing to the indignation aroused by the fact that numbers of “uitlander” settlers have been “commandeered,” which means that they have to find their own horses and arms, leave their businesses, and risk their skins, without even receiving any pay. The Transvaal authorities are within their own laws, but the affair is an outrageous imposition upon the men who, debarred from all voice in the government of the nation, supply nine-tenths of the country's revenues, and who have placed the Republic on its feet. The Europeans are developing an attitude of active resistance, and, unless the Boers are exceedingly careful, they will find themselves face to face with a very awkward position, and a body of fighting men (largely their own sharpshooting kindred from the Cape Colony) who would, if it came to blows, give them a great deal more trouble than did the red-coats at Majuba-hill or Laing's Nek. It is earnestly, most earnestly, to be hoped that the torch of war will never again be lighted in a fratricidal strife between the white races in South Africa, but people cannot suffer oppression, even from members of their own family. I think, however, that the Boers, in their slow way, will ultimately realise the perilous position in which they are placing themselves, but it must be said that the uitlanders are at last getting dangerously near to the boiling point.

Next in point of importance among the States and Colonies comes “little Natal,” whose area is less than a tenth of Cape Colony, and whose population is only some 43,000 whites, with, however, over half a million natives of the Zulu race. The Natalians, to whom responsible government has recently been granted, have hitherto insisted upon playing a lone hand in the South

African game. Natal imagines that she has been somewhat shabbily treated by her elder and more fully-grown sister—the Cape Colony—and has hitherto not been a particularly amiable member of the South African family. No doubt that feeling will give place to a more cordial one in time to come. It is worthy of note that Natal, though always spoken of as *the* English colony, is populated by a considerable number of Dutch farmers, who, however, are very quiet and unobtrusive, and who curiously enough, voted against responsible Government to a man.

Then there is the Orange Free State, covering about 50,000 square miles, with 77,000 white people, mostly Dutch farmers, and 130,000 natives. As already said, the people of the Orange Free State have been exceedingly good friends and good neighbours of ours. They have, perhaps, taken no very prominent part in South African affairs, but they have at all times been well in the van of progress, notably in the matter of railway construction. They are a very conservative people in the matter of State expenditure, the whole National Debt amounting to—if I remember rightly—£60,000. The Free State is a splendid wheat country, and one of the best for the rearing of cattle, horses, and sheep, besides which about half of it is underlaid by a great basin of coal. It has another recommendation, in that it is probably surpassed by no other place in the world as a health resort for consumptive persons. Its President, Mr. Francis Reitz, is a man of culture and liberal views; a South African, educated at the South African College at Edinburgh University, who became a member of the Inner Temple, and was called to the Bar in 1868. After practising in Cape Town for six years, he became Chief Justice of the Free State, and five years ago its President. His political platform is, internally, a united South Africa; externally, to use a sporting phrase, “England first, and the rest nowhere.” The other countries of South Africa comprise Bechuanaland and the vast province which we call Rhodesia, together with a number of small protected native States, such as Swaziland; and, lastly, there is the German Protectorate on the west, and the Portuguese possessions on the east. Between them these last-named cover quite a million square miles, and are inhabited by a native population which probably runs into 4,000,000 or 5,000,000 souls. The white population is, however, comparatively unimportant, being under 10,000 in all, of which about 8,000 are in

Bechuanaland and Rhodesia. These countries, however, especially the two last-named and German South-West Africa, are exceedingly rich in minerals, especially gold and copper; and in a very few years one may safely expect to find them with a large white population and a thriving mining industry.

The chief ambition of young South Africa, with Mr. Rhodes, Mr. Hofmeyr, and President Reitz at its head, is to effect a confederation of the British Colonies and the Republics into one self-governing dependency of the British Crown. This idea has issued from the stage of mere fancy, and has become a well-nigh assured certainty. The Cape Colony, the Orange Free State, Bechuanaland, and Rhodesia are already prepared and anxious for federation. Natal is still holding aloof in a dissatisfied sort of way, but she will come in by-and-bye. As long as the present artificial state of affairs in the Transvaal continues, that country, too, will hold aloof, but the end is merely a question of time, uitlander opinion being already strongly alive to the advantages of union. What those advantages are it is almost unnecessary to specify. Socially, it will do more than anything else to heal up the old race jealousies and animosities. Commercially, it will put an end to rival railway schemes, to competitive customs' dues, it will permit trade to flow in its natural channels, and it will consolidate the national financial credit. The great Anglo-South African Empire will confidently set about a development of a rich and fertile country, and, speaking with one voice, will no doubt receive a consideration from Downing-street, which on one or two occasions (now fortunately rarer) has been conspicuously wanting. Of the heads of this great movement, Mr. Cecil Rhodes is, of course, better known than any other in this country. Every public man has his enemies, and Mr. Rhodes is, of course, no exception to the rule. But it may be said that in the Cape Colony he carries the vast majority of public opinion with him. His has been a curious history. He originally came out to Cape for the sake of his health, and found himself in the first rush to the then newly-discovered diamond fields. This was in 1870. Without the interest of powerful friends and without capital, save that of resolute mind, and a genius which seems equally at home in the world of finance or the political arena, he amassed a large private fortune, and acquired a European reputation as the consolidator of an industry which was split up into hundreds or even thou-

sands of conflicting interests. Mr. Rhodes is strongly imbued with what Lord Beaconsfield called "the commercial spirit of the age," and a rather interesting anecdote is told bearing upon this side of his character. It was when General Gordon was sent out on the Basutoland mission that he and Mr. Rhodes were discussing the former's experiences in China. General Gordon related how the Emperor of China had taken him into the Treasury Chamber filled with gold, which he offered to him as a reward for his important services. This General Gordon declined. Mr. Rhodes appears to have expressed his surprise, upon which General Gordon asked him whether he would have accepted the gold. Mr. Rhodes answered, "Certainly, and as many more roomfuls as you like, for without money one cannot carry out one's ideas, however good they may be in themselves." Mr. Rhodes has an immense fund of energy, both physically and mentally, as is evident by the fact that he is Premier of the Cape Colony, chairman of the largest mining company, and managing director of the greatest territorial concern in the world. The secret of his success—and up to the present no material failures have been registered—seems to be his power of selecting suitable lieutenants, of whom he has quite an army, both in South Africa and in this country. His great aim is to unite the whole of the British dominions on the African Continent, and as a preliminary he is constructing a telegraph line from Cape Town to Cairo practically at his own expense.

The limits of time will not permit any more detailed remarks upon the white races in South Africa, but before I close I must make a hasty reference to the black element. The total number of natives inhabiting Africa south of the Zambesi has been computed to be 5,000,000. This is an exceedingly loose estimate, probably a long way from the actual truth, and it is probable enough that there are at least ten natives to each European in the country, and natives, too, more or less in a state of original barbarism. Under the circumstances, it is necessary for the whites who do not desire extinction to keep a firm hand on the bridle of power, especially as a large proportion of the natives—for instance, the Zulus, Swazis, Matabeli, Basutos, and others—are of a good fighting stock, who have given us a great deal of trouble in times gone by. On the other hand, it is necessary to recognise the fact that her native population is South Africa's most valuable asset. The natives provide at once a

vast labour supply, and a large market, at any rate in the more settled regions, for various British manufactures, such, for instance, as cloth. Those who have lived in South Africa grow exceedingly tired of the sickly foolishness enunciated in various halls and newspapers on the subject of the South African native. To judge from these utterances and writings, one would imagine that, under white domination, the Kaffir was shamefully maltreated in general, and that the chief mission of the whites in South Africa was to destroy the native physique with spirits, and to rob him of his land and liberty. Now, the exact converse of this is the truth. In a state of independence (Matabeli-land under Lobengula, and Pondoland under Sigcau, may be cited as well-known examples), the native dependencies witnessed, year in and year out, continual scenes of murder and misrule. It is estimated, by good judges, that Lobengula (or his impis), for instance, was in the habit of butchering Mashonas at the rate of 2,000 per annum; but they were no worse than other native races until white authority over them was asserted. Where, however, the natives have been brought under civilised laws and customs, life and property have been protected; they have multiplied exceedingly, and the Kaffir has very frequently, as in Basutoland and the Cape Colony, become possessed of very considerable wealth, and leads the life of a respectable and self-respecting agriculturist. Even the drink fiend, that curse of barbarous races, has been exorcised, in some instances—notably in the Kimberley compounds, and in the dominions of the Khama, the paramount chief of the Bamangwatos, among whom the sale or consumption of alcoholic liquors is strictly forbidden. On the whole, the natives are commonly well treated; they are not subjected, even for very terrible offences, to the recurrent lynchings indulged in in the United States, and they are generally treated with humanity and consideration.

There are two main families among the aboriginal races, one, the Hottentots and Bushmen, form two branches of the pigmy race, which was, and is still, scattered over Central Africa. The other is the nobler Bantu type, which is also pretty widely diffused over the continent, except in the more northern regions, where the Arab takes his place. The Hottentots, and their poor relations, the Bushmen, are rapidly dying out. Their language, which is disfigured by an immense number of uncouth clicks, is in construction similar, I

believe, to the languages of Europe. The Hottentots, or "Khoi-Khoi," are a pastoral people, but the hunting Bushmen lives entirely upon what game he can kill with his bow and arrows; he tends no flocks or herds; grows no corn, and dwells in caves or in the open field, with no protection save a few bushes to keep off the wind. When his supply of animal food fails, the Bushman sustains his happy existence—he is one of the merriest creatures alive—upon roots and bulbs, and larvæ and snakes, and indeed almost anything short of tenpenny nails.

The Bantu race belongs to a much higher order, and includes the Zulus, Swazis, Matabeli, Fingoes, Basuto, Gcalekas, Makatese, Bechuanas, Makalakas, and numerous other races, which are all pretty closely connected. The history of the Zulu nation affords a striking instance of the native ability sometimes found in the savage. The Zulu nation was founded by Chaka, and originally consisted of an agglomeration of innumerable tribes and sub-tribes, over whom Chaka established the domination of his own followers, merging them into the Zulu nationality, with the alternative of annihilation. Absolute chastity was enforced upon the males and females alike by terrible penalties, which were invariably enforced; and every able-bodied male formed part of a perfectly organised military system, and was subject to extremely rigorous training. Chaka, whom they call "the Napoleon of South Africa," was ultimately murdered by two of his sons, not before, however, he had slaughtered probably a million human beings, and practically depopulated south-eastern Africa of its original inhabitants. However, his works have lived after him, and to this day his military system, with his regimental kraals, survives among the Zulus, and their numerous off-shoots, among whom may be mentioned the Matabeli, and our good friends the Swazis. Certainly cowardice is not one of the failings of the pure-blooded Zulu. We shall not readily forget what trouble they have given us ever since the thirties, when Dingaan murdered Retief and his followers; in the Zulu War of 1877, when 700 of our troops were annihilated at Isandlwana; nor must we forget that throughout the recent campaign the Matabeli maintained the traditions of the races for a splendid courage, which, however, was of no avail against the steady coolness of the Rhodesian columns.

I am afraid that this paper has been some-

what wanting in sage reflections or brilliant conclusions. I hope, however, that those of you who have not visited South Africa, or studied its racial conditions, will derive some impression of them from what I have said. In its white population, South Africa has a self-relying and energetic people, who have done wonders with the limited resources at their command, and in the aborigines the country possesses a number of intelligent and industrious native races, who are, unlike the Redskins of North America, available as a magnificent labour supply, and who, though their numbers constitute an element of danger, and require considerable care of treatment, have done a great deal to advance the development of South Africa.

DISCUSSION.

Rev. H. WALLER, as one who had taken a great interest in the march of events in South Africa, and who took his first lessons under Dr. Livingstone on the Zambesi and Shiré, said he might be allowed to emphasise what had been said in the paper. From the point of view of the abolition of the slave trade, he looked on the development of the mineral resources of South Africa as one of the most astonishing things in favour of native life that it was possible to conceive. Right away up Lake Nyassa the news that the white man wanted men to employ in the diamond and gold-fields was well understood. He did not know that many natives to the north of the Zambesi crossed it to go into Mashonaland, because there had been a great development of civilisation in Nyassaland itself, in coffee growing, and so on. As a matter of fact, they were attracted in thousands annually, and so far had the development of English industry assisted in supplanting the slave trade in parts of the country where he was with Dr. Livingstone. That where boys and girls were sold for five or six yards of calico a-piece, the same class were now sending to England to buy watches, and good watches, too, out of the wages they earned! As a natural result, instead of the chiefs wishing to send their people out of the country as slaves, they found it far more to their interest to retain them in the country, because they added to the tribal strength and riches. This introduced an exceedingly interesting problem. He hoped that the reader of the paper would have enlarged on one point, viz., that the white men engaged in these mineral industries to the south were fully alive to the fact that it would be really suicidal to create a scare amongst the natives by such bad treatment, as would lead them to retreat to the more savage countries they had left, instead of coming where good wages were to be earned. It

always seemed to him, when among these people, that a native coming in contact with a European was very much like a snail coming out of its shell; he was full of dread, his mind had been filled with stories which the Arab slave dealers told him, but if he were encouraged, he would become very friendly, and lay aside his suspicions, and, personally, he was never more faithfully served in his life than by these men. But once you offended them, it was like hitting a snail on the horns; he crept into his shell, and you might crush him, but he would not come out, whatever you might do. It was so with the Zambesi people; they were all of the same disposition. If the white man would only be friendly to them, and guard them against those vices which were ready to crop up, the African race would be the most faithful servants Europeans could have. Mr. Wills had touched on the question of the drink traffic; he was not a teetotalter himself, and had not much sympathy with teetotalters, but looking into the question of the importation into the country of German potato spirit, he knew what a great temptation it was to men, as a last resource, who could not get on in any other occupation, to run a canteen, and he was afraid there was a seamy side to what had been told them that night. There were some men so unprincipled as rather to prefer a Kaffir who had a taste for drink. Those who did not drink, as a rule, would work for a certain time, and then go back to their own country, but a man who had taken to drink found himself glued to the spot where he procured it; and that was an inducement to some unprincipled men to rather wink at the drink traffic, and possibly to encourage it. But, thank God, there were right-minded men enough to insist on common sense coming to the front. The very essence of common sense was to show these poor natives that the work could not be done by Europeans, especially as you got into the hotter and more unhealthy parts of the country, but that it could be done by the natives, and inasmuch as a faithful servant and an honest man was worth a great deal more than a scoundrel, it would be the soundest economy to uplift these men and aid them. He was quite certain that the discovery of these extraordinary mineral deposits in South Africa, which Providence had divulged to us, would be of immense advantage in helping Europeans to do their duty to those amongst whom Providence had led them. He could remember the days when Dr. Livingstone used to look at these problems, and to hope that something would eventuate to help the natives. It was almost like a dream to look back upon those times. He thought the gold development was only in its infancy, and whilst silver had so increased that the silver in half-a-crown was now only worth two shillings, if so much, he was afraid the puzzle some 40 years hence would be to know what was to be the value of an ounce of gold.

Mr. C. HINDLEY thanked his old schoolfellow, Mr. Wills, who had given them a great deal of useful infor-

mation. He also thanked the last speaker for referring to Dr. Livingstone, and thought that if Mr. Wills could have added to his paper at all it might have been a reference to the great pioneer work done by some of the missionaries in Africa. They owed a great debt of gratitude to the missionaries for what they did in this way, of which we were now reaping the benefit in the £10,000,000 of gold produced every year. It was quite possible that these gold-fields would settle the question of bi-metallism, by providing enough gold to make that system unnecessary. He should like to have heard something about the building material in use in the Cape. Views had been shown of very fine buildings, some of which appear to be of similar stone to that in use in this country, but he did not suppose the stone was imported. Of course, if there were granite rocks there, that might be used. He should also like to know if there were any more churches and chapels belonging to different denominations than had been put before them, as there were not many in the illustrations.

Mr. FRANCIS COBB had had a great deal of experience of natives in various parts of the world, and he put the Zulus in advance of any natives he had had to do with; they were staunch friends, magnificent hunters, and good soldiers, and they would follow a white man in whom they had confidence almost anywhere, but best of all they were, before they mixed too much with the whites, the most honest race on the face of the earth. He had tempted them in different ways to steal, but had never succeeded. One of their great ambitions used to be to have a small American axe, but he had taken his axe at night, when going into his tent, and thrown it as far as he could towards a little path which led to their kraal, and he found the axe there in the morning, although there had been many groups standing around it. The only way in which he partially succeeded was by upsetting a keg of nails near the same footpath. The men came and looked at the nails, and wished they had some, but went on their way. Presently, when the women came carrying their grass, they stopped, and some picked up a few, and carried them away with them; but the next morning those that had been taken away were sent back to his tent. With regard to their bravery, he would give only one instance. Some animal of the tiger description had carried off a young calf one night, and they started to look for the tiger the next morning. They came to a place where the thick under brushwood was so dense that it was impossible to follow the track at all, but there was a round hole where the tiger had passed through. The track was perfectly clear, and looked as if it were a cave which the tiger had got into. While he was discussing the matter, the chief said something to two young warriors, who at once threw down their long assegais, took their short ones, and went on their hands and knees, one after the other,

into the hole before he could stop them. It turned out that the tiger was not inside, but had gone through beyond, but still that was an instance of bravery, that these young men should have gone in through a place where, in a dark and confined space, they thought to fight the tiger hand-to-hand.

The CHAIRMAN, in putting the vote of thanks to the reader of the paper, said Mr. Wills had stated the question very succinctly and completely, and had dealt with many burning questions in very moderate terms. The future of South Africa would open out questions of interest from an economic and political point of view, second in interest to none which had been dealt with in modern times. There had undoubtedly been much mismanagement in the past on the part of the agents of the home Government. The native races are not likely to unite in concerted and planned action against the whites. Johannesburg will probably become a great railway centre. The union of the South African colonies and States in one confederation would be an important step, and they would be glad to hear on such competent authority that it was likely to take place within a measurable distance of time. The great danger in England in dealing not only with South Africa, but with our possessions in other parts of the world, is the tendency in august assemblies, and elsewhere, to encourage the fads of very well-intentioned people, who looked at things with entire ignorance of the circumstances of the case.

The vote of thanks having been carried,

Mr. WILLS, in response, said it gave him great pleasure to see there the Rev. Mr. Waller, whose name was so well known in the Zambesi regions. He had not touched upon the effect which the opening of South Africa would have on the slave trade, because, as a matter of fact, it was confined to the north of the Zambesi, while he had been dealing with that part of the continent which lay to the south. There was no doubt they must look to commerce for the extinction of the trade in human beings. The efforts of a few traders would do far more than the British cruisers on the African coast, on which so many millions of money had been spent. He quite agreed with Mr. Cobb's remarks as to the noble instincts of the Zulu race; there was no limit to their courage, and in their own kraals they were undoubtedly one of the most honest of the races of mankind. But he was afraid that contact with the whites would inevitably bring about some deterioration, for though in their kraals they might not steal any of Mr. Cobb's nails, on two separate occasions his "boys" had possessed themselves of his watch and chain. The burning question was that of drink. In their own kraals they confined themselves to native beer, which did them no harm, but when they came in contact with the white man their national physique and self-respect

suffered from the potato spirit which had been referred to. He feared nothing could cope with that evil but legislation, but, curiously enough, the only two people in South Africa who had endeavoured to effect such legislation were Mr. Rhodes, at Kimberley, and the Chief Khama, in Bechuanaland. In the Transvaal the trade in spirits flourished to an alarming extent, and was encouraged by the Government, who were anxious to swell their revenues. With regard to building stone, South Africa possessed nearly all the stone required for building purposes. Practically the whole of Mashonaland and Matabeliland, he believed, lay on granite, and throughout the rest of South Africa there was any amount of limestone and sandstone, but the material most often used in the construction of houses was brick, frequently cased in galvanised iron or coated with Portland cement. In the chief public buildings stone was largely used. As to the religious denominations throughout the country, the Dutch themselves were a deeply religious race. In that, and in one other respect, they resembled the Puritans of Cromwell's time; they went about with the Bible in one hand and a rifle in the other, and were continually adorning their conversation with Scriptural quotations. With regard to churches and chapels, which were of almost every Christian denomination, the usual complaint was that they were rather too many in proportion to the population, and the clergy were almost too numerous for their congregations. What the Chairman had said with regard to the encouragement of "fads" hardly applied to colonial statesmen; as a class, they were business-like and practical statesmen, and there seemed too many important matters to attend to leave much time for exploiting "fads." Their chief concern in South Africa was to keep themselves alive by keeping down the native races, and to develop the industrial resources of their country. He concluded his observations by expressing his obligation to Sir Donald Currie for the loan of the views with which he had illustrated his paper.

Miscellaneous.

THE POULTRY INDUSTRY IN CHINA.

The breeding and rearing of fowls is an important industry in China, as they form a very considerable portion of the daily food of the better class of the people. The United States Consul at Chin-kiang says that the varieties of fowls are few in number. The principal are the Yangchow fowl, a large bird of good flavour, which weighs from 4 to 6 lbs. This variety is a good layer and sitter, the eggs being of brownish tinge and good size. It lays, during eight or nine months of the year, about 200 eggs, ceasing only in the hot summer months. This

description is kept more for the table than for laying purposes, as its flesh is particularly good. The Langshan fowl is a distinct and fairly pure breed from the Yangtze River region, just below Chinkiang. It is a large, heavy, handsome bird, weighing from 7 to 8 lbs. The eggs are of darkish brown, and of good size. The Black Bone or Typhoon chicken is a distinct fancy breed. In colour it is white, and its skin, legs, bones, flesh, and comb are very dark. The flesh of this fowl is much esteemed, and, boiled down into soup, it is prescribed by physicians for certain diseases. The Chow is another variety. This breed is small, weighing generally from 2 to 3 lbs. A pure white cock of this breed is always carried on the coffin at a native funeral *cortège*, and is sacrificed at the grave. Also on native boats a cock bird is killed on the Chinese New Year's Day, and the blood sprinkled on the bow to propitiate evil spirits, and to insure good luck during the year. Ducks are reared in great quantities, and are largely used as food, both fresh and salted. They are all artificially hatched, as the duck is an uncertain sitter. The common duck is a good-sized bird, weighing, when dressed for the table, three or four pounds, and is much esteemed for the excellence of its flavour. After fledging, the birds are driven about in vast flocks through canals, and from pond to pond, where they find their food. They are brought under strict discipline, and obey their keeper's call with extraordinary intelligence. The Mandarin duck is smaller than the common duck, and is a beautiful bird, with diversified and brilliant plumage. It is reared chiefly for its beauty. In the grounds of the wealthy there is always an artificial lake, where the Mandarin duck is kept. They are considered as emblems of conjugal fidelity, and a pair of them usually form a part of wedding processions. Preserved ducks' eggs are considered a delicacy, and always form an important part of a mandarin dinner. The process of preserving them is as follows:—A lye of beanstalk and lime is made by burning these to powder. This is put in water, black tea leaves and salt in certain proportions being added. The boiling is continued until all the water has evaporated, and the residue becomes caked and hard. This is powdered fine, and the fresh eggs are placed therein one by one with a little rice husk. They remain in this preparation one hundred days, when they are ready for use. The preserved eggs will keep for several years. When ready for use they have the appearance of hard-boiled eggs. The shell is taken off, and they are put on the table cut into small slices and eaten as *hors d'œuvres*. The goose is generally of pure white plumage, very striking in appearance, of great size and majestic carriage, much resembling the swan. The turkey has long been introduced into China, and is reared at Canton and Tien-Tsin entirely for foreign markets, that is, for the foreigners at the treaty ports. The peacock is reared in many parts of China, and has long been known to the people, though it is not a

native of the country. Its tail feathers are used by the mandarins in their caps to designate official rank. The gold and silver pheasants of China may be called domesticated birds, as they are now so extensively reared that it is doubtful if they are found wild. There is a bird in China—the cormorant—which is domesticated, trained to wonderful intelligence, and employed in catching fish. These birds are reared and trained with great care. A pair costs from five to six dollars. They are taken out on the lakes and rivers in a small boat; one man to every ten or twelve cormorants. The birds stand perched on the sides of the boat, and, at a word from the man, they scatter on the water and begin to look for fish. They dive for the fish, and then rise to the surface with the fish in their bills, when they are called back to the boat by the fisherman. As docile as dogs, they swim to their master and are taken into the boat, when they lay down their prey and again resume their labour. The use of incubators in hatching eggs has been known and practised in China for several hundred years. It is a large and profitable industry, but the apparatus used is of a very primitive description. The hatching house is usually a long shed built of bamboo, the walls plastered with mud and thickly thatched with straw. Along the ends and down one side of the building are a number of round straw baskets plastered with mud to prevent them from taking fire. A tile forms the bottom of each basket. Upon this the heat acts, a small fireplace being below each basket. Upon the top of the basket there is a straw cover, which fits closely, and is kept shut during the process. When the eggs are brought they are put in the baskets, the fire is lighted beneath them, and a uniform heat maintained. In four or five days after the eggs have been subjected to this temperature, they are taken carefully out, one by one, to a door, in which are a number of holes nearly the size of the eggs. They are held against these holes, and the attendants, looking through them, are able to tell whether they are good or not. In nine or ten days after this, that is, about fourteen days from the commencement, the eggs are taken from the baskets and spread out on shelves. Here no fire heat is applied, but they are covered over with cotton and a kind of blanket, under which they remain about fourteen days more, when the young chickens break their shells and come forth. The natives engaged in this business know exactly the day when the young chickens or ducks will come forth, and are ready for their arrival. They are generally sold two or three days after they are hatched.

THE AGRICULTURE OF HONDURAS.

The agricultural products of the Republic of Honduras, most of which are capable of considerable extension, are tobacco, sugar, maize, wheat, coffee, potatoes, indigo, cocoa, bananas, indiarubber,

and *pita* (the fibrous product of the *agave* tree), used by the native population in the manufacture of hammocks, &c. In former times the forests constituted the principal agricultural wealth, lumber consisting chiefly of its world-renowned mahogany, being exported on a large scale to the United States and Europe, but the industry has not flourished of late years, owing to want of enterprise. Her Majesty's Consul-General at Guatemala says, that an endless variety of fruit trees is found in the Republic, most of which are indigenous to the soil, and form, in addition to the various preparations of maize and black beans, called *frijoles*, the staple food of the lower classes. Among these fruits may be mentioned the mango, pineapple, custard apple, alligator pear, lemons, limes, oranges, and bananas, the latter forming an important article of export. The cultivation of such fruits as strawberries and cherries, in fact, all those indigenous to a cooler clime, has not met with any great attention, but could doubtless be grown with successful results in the temperate zones. An important article of export is tobacco, which is the finest grown in Central America, and is said by some to equal the Havana product. This is one of the oldest agricultural industries in Honduras, having flourished as far back as the last century, when it was grown with great success in the department of Santa Rosa. The industry has flourished satisfactorily, and considerable quantities of tobacco are annually exported, a large portion to Havana, where it is re-dressed and sold in a manufactured state as Cuban leaf. Coffee, the staple export of the neighbouring Central American Republic, has never engaged much attention in Honduras, although the berry grown there is asserted to equal that of Guatemala and Costa Rica. The sugar industry is also in a backward state, and in this, as with coffee, there is room for considerable development. Mr. Gosling states that the former might well constitute an important article of export, as the cane is of superior quality and thrives remarkably well, both in the plains and mountain districts. It is estimated that there are about 800 acres devoted to the cultivation of sugar in the Republic, the departments of Comayagua, Gracias, Yoro, and Santa Barbara being the chief centres of the industry. One of the staple agricultural products of Honduras is the banana, large quantities of which are annually exported to the United States. It flourishes best on the Atlantic coast, where it is marvellously prolific and commercially successful. Another branch of agriculture eminently suited to the soil is the cultivation of indigo. As yet, however, it is only grown on a small scale by the Indian population, but it has attracted attention in the United States from its superior quality, and in the valleys of the Chamelecon the plant is at present being largely sown. Last year the trade was unusually brisk, and large exports were made to France. Maize grows throughout the country in a semi-wild state. Wheat and other cereals are successfully raised, but the amount produced does

not suffice to meet the requirements of the country. Rice is grown in small quantities by the Indian population, who also cultivate potatoes and cochineal, cotton, vanilla, sarsaparilla, and numerous other minor agricultural products. Cattle-breeding is among the most important industries in the country, and live stock forms one of the chief articles of export, while in dairy-farming there is, according to Mr. Gosling, a decided opening for the foreign settler. In the capital and towns throughout the country cows' milk is scarce, and is retailed at almost prohibitive prices. As a natural consequence, the manufacture of butter is small, and what is obtainable is of very inferior quality. Large quantities of thin cheese are made for home consumption, but it is of a poor quality. In conclusion, Mr. Gosling says that there is room for considerable development in all branches of the agricultural industry in Honduras. This is, however, not due to any want of success on the part of the agriculturist, but is directly attributable to the sparseness of the population, demonstrating equally the wide field existing in Honduras for foreign immigration and private enterprise.

Notes on Books.

THE ART OF ILLUSTRATION. By Henry Blackburn.
London: W. H. Allen. 1894.

In this handsome quarto volume Mr. Blackburn has treated at greater length and with greater abundance of illustration the subject of his recent course of Cantor Lectures. The chief feature of the book is the abundance of examples of the various methods by which books and newspapers are now illustrated, and of the various characters of the illustrations employed. Specimens of the results of most of the "processes" are given, not omitting even photographs from life, reproduced by a tint process (a general name for this method appears to be wanting). Examples are given of line drawings and wash drawings in many different styles, converted into relief blocks, and from the manner in which they are printed a good notion can be obtained of the best results to be expected in work of this sort. A brief account of some of the methods employed is given at the end of the book, but this is only supplementary, as Mr. Blackburn confines himself almost wholly to the artistic side of his subject, and deals but slightly with the technical.

MICRO-ORGANISMS IN WATER. By Percy Frankland, F.R.S., and Mrs. Percy Frankland. London: Longmans. 1894.

In the course of Cantor lectures which Dr. Frankland delivered in 1892, on "The Chemistry and Bacteriology of the Fermentation Industries," he described the method of cultivating bacteria, which,

first introduced by Koch, has led to the "separation and individualisation of so many micro-organisms," and has since been the means of obtaining nearly all the knowledge we possess of these ubiquitous and important, though minute forms of organic life.

The earlier investigators, Tyndall, Bastian, and others, were content if they could prove the presence or absence of microbes in flasks of sterilised fluid. They were unable to separate the different kinds, or to form any quantitative estimate as to the number of bacteria. Koch was led to the idea of cultivating the organisms in solid media, and by a homœopathic process of dilution he was able to obtain separate "colonies," or groups, the produce of a single individual, and, therefore, all of identical species. Further, this separation enabled the number of individuals existing over a certain area to be counted, and thus an estimate to be formed of the total number existing in a certain measured quantity of the material.

Dr. and Mrs. Percy Frankland's book is an account of the researches which have been made by Koch's method, and by the various elaborations since introduced in that method, in the bacteriological study of water. The bacteriological examination of potable waters is now at least as important a means of determining their character as their chemical examination, and it has provided a most valuable test of their suitability for dietetic use. How far such examination can discriminate between innocuous and pathogenic germs is, perhaps, a question that may be left to the discussion of experts, but there can be no question as to the accuracy with which the existence of organic germs can be ascertained, and their proportion estimated.

The authors describe in the earlier chapters of their book the methods of cultivation and examination of micro-organisms, and then pass to the discussion of the methods used in the examination of water, and the results obtained by such examination. The consumers of London water will be gratified by the evidence produced to show the beneficial effects in diminishing organic life, of ordinary filtration through sand and gravel, while those who use ice freely as a luxury will be surprised with the results of the examination of samples of ice supplied for domestic use. In many cases the ice showed a larger proportionate number of organisms than ordinary unfiltered Thames water near the intake of some of the water companies. This seems to be due to the fact that the low temperature which suffices for the destruction of the bacteria themselves, is unable to destroy the spores.

The final chapter deals with the action of light on micro-organisms. It has been found that light (especially, or perhaps solely, the rays of higher refrangibility—the blue and violet rays) have an absolutely destructive effect on some organisms, so much so that a sharp picture, a true photograph, can be obtained by screening certain portions of a plate covered with culture material thickly sown with bacteria. The bacteria will develop in the shaded

parts, while the parts exposed to light will remain unaffected and clear. A sharp "photobacteriograph" of the word *TYPHUS* is reproduced as an illustration to this part of the book.

NATURE'S HYGIENE: a Systematic Manual of Natural Hygiene, containing also a detailed account of the Chemistry and Hygiene of Eucalyptus, Pine, and Camphor Forests, and Industries connected therewith. By C. T. Kingzett, F.I.C., F.C.S. London: Baillière, Tindall, and Cox. 1894. 8vo.

This the fourth edition of a book which has already been noticed in the *Journal*. It was first published in 1880, and has been gradually enlarged. The present edition contains a chapter on some new developments of bacteriological science, and also one on alimentation and foods. The first part, consisting of eleven chapters, deals with the chemistry and hygiene of the atmosphere, water supply, and sewage contamination, infectious and contagious diseases, bacteriological studies, antiseptics, &c., and the second part, consisting of four chapters, deals with the sanitary properties of eucalyptus, pine, camphor, &c.

General Notes.

AUSTRALIAN MOVEMENTS OF CAPITAL.—The inward and outward movement of capital to and from New South Wales and the other Australasian colonies during the period 1871 to 1892, both years included, has been approximately estimated at £339,725,000 inward and £252,837,000 outward, the excess of capital introduced over withdrawals being £86,880,000. Of these amounts the capital introduced into New South Wales absorbed £92,202,000, the outward flow being £69,753,000, leaving an excess of £22,449,000 of capital introduced over withdrawals.

ROYAL STATISTICAL SOCIETY.—The Council of the Royal Statistical Society announce that the subject of the essays for the Howard Medal, which will be awarded in 1895 with £20 as heretofore, is as follows:—"Reformatories, and industrial schools of that class, in their relation to the antecedents, crimes, punishments, education after conviction, and training of juvenile offenders: together with the nature and extent of their influence on the diminution or increase of crime generally. These particulars to be collected and analysed on a statistical basis, both as respects the institutions and agencies, public and private, at home and abroad, for the reclamation of juvenile offenders, and the best means of dealing with them on release. This does not include the industrial and training institutions certified by the Local Government Board under the 25 and 26 Vict., cap. 43." The essays should be sent in on or before the 30th June, 1895.

Journal of the Society of Arts.

No. 2,173. VOL. XLII.

FRIDAY, JULY 13, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CHAIRMANSHIP OF COUNCIL.

On Monday, 2nd inst., at their first meeting after the annual election, the Council elected Major-General Sir John Donnelly, K.C.B., as Chairman of Council for the ensuing year. The various Committees were also re-appointed.

Miscellaneous.

POTTERY EXHIBITION AT THE IMPERIAL INSTITUTE.

The Executive Council of the Imperial Institute have decided that the United Kingdom Section of the Imperial Institute will be best utilised, and the resources of the home country most effectively displayed, by a series of Exhibitions illustrative of the leading industries and manufactures of Great Britain and Ireland, and the first of these Exhibitions, devoted to Decorative and Artistic Pottery and China, and Optical, Decorative, and Artistic Glass manufactured in the United Kingdom, and to the practical illustrations of processes in the manufacture of pottery, china, and glass, was opened by H.R.H. the Prince of Wales on Saturday, the 12th May last. The Exhibition will remain open during the summer and autumn. In addition to the collection of pottery, china, and glass exhibited by manufacturers, there is a fine display of china and pottery manufactured in the United Kingdom from 1600, lent by well-known collectors.

Some of the earliest examples of old English pottery are found in the tiles so extensively used in ecclesiastical buildings, and Messrs. William Godwin and Son, of Lugwardine Works (Withington, Hereford), exhibit an interesting series of early English tiles, of the 14th, 15th, and 16th centuries, found during restoration at Gloucester, Salisbury, Hereford, and St. David's Cathedrals; also at Ewenny Abbey, Milton Abbey, St. Peter's Church, Hereford, &c. Many of these tiles have inscriptions upon them, as on one found at Ewenny

Abbey, and dated 1509, is Abbot Parker's motto, "Raise up those drowned in guilt."

Sir John Evans, K.C.B., contributes an Elizabethan tile supposed to have formed part of a stove; four wine bottles inscribed "Sack," "Whit" (for white wine), dated respectively 1644 and 1646, &c., and with the initials of the owner and his wife; two pill slabs, on one of which the arms of the Apothecaries' Company are displayed; and a basin with "Success to Trade" inscribed upon it. Sir John Evans also sends six dessert plates of Lambeth ware, with these inscriptions:—

- (1) What is a merry man?
- (2) Let him do all he can
- (3) To entertain his guests
- (4) With wine and merry jests;
- (5) But if his wife do frown
- (6) All merriment goes down.

Prof. A. H. Church exhibits six specimens of Staffordshire salt-glazed stoneware made in the 18th century, consisting of sauceboat, decorated with figures in relief of the Seven Champions of Christendom, teapot and cover, bowl, oval dish, octagonal plate, and ribbed coffee cup. Sir Henry Doulton also sends some interesting old specimens of pottery, consisting of a Lambeth delft vase, a jug by Dwight, of Fulham, about 1700 (trial of Delft ware), and several specimens of Burslem white salt-glazed ware. Major Henry Palmer contributes a considerable collection of Turner pieces, including jasper ware, stoneware, Egyptian black, &c. John Turner, potter of Lane End, Staffordshire, established a pottery in 1756, and died on December 21, 1787, aged 49 years. His sons, William and John Turner, succeeded him, and continued successfully to produce all the various descriptions of pottery for which their father was celebrated. On January 9, 1800, they patented a new method of making and manufacturing porcelain and earthenware, marked "Turner patent," or patent stone. In consequence of great losses, occasioned by the French Revolution, they were compelled to give up their works in 1803. Dr. G. H. Rodman sends some specimens of the old Mortlake pottery made by Joseph Kishere, of High-street, which dates from the early years of the present century. Sir Richard Phillips, writing in 1817, says:—"I viewed a manufactory of delf and stoneware, for which, amongst potters, Mortlake is famous. The principal articles manufactured are brown stone jugs, and the groups on the jugs were exactly similar to those on the common pottery of the Romans." Sir Henry Doulton also exhibits specimens of Mortlake stoneware.

In the loan collection there are a large number of fine examples of old Wedgwood ware, consisting of busts and statuettes in black basalt, vases in white jasper, with sage embossments, and blue jasper with white embossments, medallions, plaques, &c., &c. Mr. W. E. Darwin shows specimens of a Nelumbian dinner service, designed to represent the three kinds

of lilies mentioned by Dr. Erasmus Darwin, in his "Botanic Garden," and Mr. Godfrey Wedgwood a black vase, with red Etruscan figures (one of the vases thrown by Josiah Wedgwood, Bentley turning the wheel, on the day of the opening of the Wedgwood works at Etruria) in 1760. The present firm of Josiah Wedgwood and Sons claims to be the oldest firm in the Potteries, and the business has been carried on ever since the death of the original Wedgwood by his descendants, the present firm being the fourth and fifth generation by direct descent. Sir Henry Doulton shows some dinner plates of different designs by Elijah Mayer, who was a contemporary of Wedgwood, and commenced business about 1770. He was noted for cream-coloured ware (very similar to that produced by Wedgwood), black basalt, &c. In 1869, on the death of Joseph Mayer, a quantity of ware, which had been hidden away for over thirty years, was disposed of by auction. Sir Henry Doulton also shows some specimens of Early Doulton stoneware, one of which is a water bottle made to represent the figure of Lord Brougham, and labelled "The True Spirit of Reform," and a Doulton vase, which is interesting as the first piece of coloured stoneware made by his firm. It was exhibited at Paris in 1867.

So much having been said of the historical specimens of pottery, it is necessary to pass on to notice the specimens of old English porcelain. Some fine specimens of Chelsea china are lent by the Earl Cadogan, Miss Mary E. Teesdale, and Mr. Lawrence W. Adamson. The latter shows a pair of plates painted with birds, borders *gros bleu* with gold butterflies and festoons of flowers. These are described as part of a service made for the Duchess of Mecklenburg Strelitz, and if so, they must be part of the service described by Horace Walpole, in 1763, in a letter to Sir Horace Mann as being made for the King and Queen to present to the Duke of Mecklenburg, and as having cost £1,200.

Lord Cadogan and Miss Mary Teesdale show specimens of Worcester china, and a fine collection of various dates is sent from the museum of the Royal Worcester Porcelain Works, Worcester. First, there is Dr. Wall's Tonquin china, then the transfer printing of 1756, next the productions of the firm of Flight and Barr (1783 to 1830), and, lastly, the works of the two Chamberlains. Specimens of Spode china is shown by Mr. R. P. Copeland, Mr. W. F. M. F. Copeland, and Mr. Hawtrey Collinssplatt, of Brixton-house, Plymouth. Josiah Spode is said to have been the first English potter to use bone in the manufacture of porcelain.

A large collection of Crown Derby in great variety is lent by Sir John Swinburne, Bart., R.N., and fine specimens are contributed by Mr. Hawtrey Collinssplatt, Mr. and Messrs. Hughes, and Mr. Lawrence Adamson. Amongst the latter's contributions is a pair of mugs richly gilt on white ground, each painted with a representation of the Battle of the Nile, and medallion portraits of Lord Nelson,

These mugs were intended for presentation to Lord Nelson from Alexander Davison, his agent, and were copied from the medal presented by him to each officer and man of Nelson's fleet.

Specimens of the manufactories of Plymouth and Bristol will be found in the collection, and special interest is attached to the productions of these two places, as it was here alone in England that attempts were successfully made to produce hard paste or true porcelain. Sir George Birdwood shows a small centrepiece of Cookworthy's Plymouth china, formed of open conch shells, three below and one above, resting on a rockwork covered with a variety of small shells.

Mr. Samuel Hoare, M.P., contributes a fine collection of Lowestoft china (which, however, is not described as Lowestoft in the catalogue), and an earthenware mug, inscribed "James and Mary Curtis, Lowestoft, 1771." Earthenware was manufactured at Lowestoft as early as 1752, and in 1757 a porcelain factory was established by Messrs. Walker, Browne Aldred, and Rickman. In 1802 the works were abandoned.

Lord Swansea lends two cases full of old Swansea china. This beautiful manufacture of the Welsh town was only produced for a few years. The fine translucent paste which has caused the Swansea porcelain to be so renowned was not produced until 1814, and in 1817 the manufacture was discontinued. Some opaque china of an earlier period is much admired on account of the beauty of painting upon it. In 1802, when Mr. L. W. Dillwyn purchased the works, he employed Mr. W. W. Young to draw birds, butterflies, and shells upon the china.

To turn from the historical specimens on loan to the productions of the existing firms of potters, special mention must be made of the grand displays of the Royal Porcelain Works, Worcester, Messrs. Josiah Wedgwood and Sons, Messrs. Mintons, the Coalport China Company, Messrs. Brown-Westhead, and Company, and Messrs. Doulton and Company. The productions of the Worcester Company vary greatly from the historical specimens, and the blue dragon design, which was so marked a feature of the old Worcester, is not seen among the modern examples. The specialties of the collection are the ivory porcelain with encrusted gold and colour decorations, ivory and rose coral, Pompeian green, the pierced work, &c. The objects are vases, jardinières and flower pots, figures and statuettes in stained ivories, rich plates and services, &c.

Messrs. Josiah Wedgwood and Sons exhibit jasper ware, black basalt, Queen's, or ivory ware, &c., and the firm have in their possession the original moulds for the jasper ware by Flaxman, Webber, Hackwood, and others. The Victoria bas-relief ware is a quite modern production, and it has a very fine effect in the cases, gorgeous as it is with gold and colours. The firm also exhibits specimens of china. Josiah Wedgwood produced what he called white porcelain biscuit, but

the paste he used was not, strictly speaking, porcelain. True porcelain was made for a time by his nephew, Thomas Byerley, but the manufacture was discontinued after the peace of 1815. In 1879 it was again made at the works of Etruria.

The Coalport China Company exhibit vases, jardinières, breakfast, dinner, and dessert services, &c.; one dessert service is beautifully decorated with portraits of such celebrated beauties as Lady Sarah Bunbury, the Duchess of Devonshire, and Mrs. Mary Robinson, after Reynolds; the Princess Royal, after Gainsborough; and Lady Hamilton, after Romney; another service is decorated with views of English cathedrals.

Messrs. Mintons have a large exhibit of a very varied character; and special mention must be made of the vases with *pâte-sur-pâte* ornament, by Solon, and the reproductions of old Henri II. ware. Nos. 50 and 106 (case B) are a pair of ewers which are exact reproductions of old Henri II. pieces. The ornament is inlaid with coloured clays, as in the original.

Messrs. Doulton and Co. exhibit a large collection of the productions of their Burslem works, as well as the Doulton ware made at Lambeth, in endless variety. There is the English history vase, by G. Tinworth, and several relief panels by the same artist. Messrs. Doulton exhibit a throwing-wheel and a potter's wheel in action, and also some of the processes of relief moulding and faïence painting. The following description of processes will be of interest:—

Description of Processes Exhibited by Doulton and Co., of Lambeth and Burslem.

Throwing.—The first process exhibited is that of "throwing." Throwing is the technical term applied to the production on the potter's wheel of all vessels of a circular form. It is simply the *throwing down* in the centre of the revolving disc of a lump of clay which is to take form and life in the hands of the potter. Work formed in this way is termed "thrown," in contradistinction to work made only in a mould. The vessel is formed entirely by the motion of the hand upon the revolving lump of clay, no shaping tool being employed. A small piece of wood or iron, termed a "rib," is sometimes used to remove the slight roughness left by the fingers. Where this is not necessary, the vessel can be entirely formed by the hand alone.

Second.—Lathing, or Turning.—In some instances the form of the vessel is such, that the lower portion of the clay mass is too weak in the soft state to support the upper. When this is the case a greater thickness of clay is left below than is required for the final form. To remove this, recourse is had to the process of lathing, or turning. As soon as the vessel attains a certain hardness the workman places it upon a lathe, and, while it revolves, cuts it to the necessary thickness, applying, at the same time, the required mouldings and lines by means of runners and tools. Early training and a good eye for form

are required, and experience alone will give that fine, true, and highly polished surface so essential to the higher kinds of ware.

Third.—Etching and Carving.—The ware being still in the plastic state, is now passed to the designer, who carves or etches the surface in such parts as require this class of decoration. Any portion of the design to be raised can now be added by modelling or *appliqué* decorations. Lines or bands of slip (*i.e.*, clay in the liquid state) are added if necessary, and the vessel is allowed to dry. It is then passed to the kiln, in which, if the decoration is complete, it receives its final firing.

Fourth.—Under-glaze Painting or Lambeth Faïence.—In some classes of the ware, portions of the design are painted in under-glaze colours upon the ware, and previous to this the vessel is only partially fired, being, in this state, called "biscuit." The colours do not at this stage appear fully developed. In order to produce the finished result, the vessel bearing the painted design is first slightly heated, to destroy the oil with which the colour is mixed, and afterwards dipped with a coating of thin liquid glaze. It is now ready to be placed in the glaze kiln, or "glost oven," and when fired to a temperature sufficient to melt the glaze, the design appears in its full brilliancy of colour through the transparent coating of vitrified glaze. The ware can, if necessary, receive further decoration in gold or enamel upon the glaze, and be passed again to the kiln to be fired at a lower heat.

Fifth.—Salt-Glazed Ware.—It will be noticed from the above description that faïence ware undergoes a series of four separate firings, some before decoration and some after. In the manufacture of salt-glazed ware, however, this is not the case. All the processes of carving, decorating, and colouring are completed before the first and only firing. The ware is not dipped in glaze at all, but when the kiln has attained a white heat, common salt is dropped through a number of small apertures in the roof of the kiln. This salt rapidly vaporises, and the soda of the salt, combining with the silica of the ware, produces a thin coating of glass on the surface.

Messrs. Doulton also exhibit their patent metallo-k ceramic joint, by which metal and pottery, and metal and glass, can be incorporated. This is useful for pipes and other sanitary purposes, and for the exhibition of indentures and documents written on both sides of the paper.

Messrs. William De Morgan and Co. exhibit a case of lustre and under-glaze Persian pottery, also lustre and Persian tiles on the walls. Messrs. Brown-Westhead, and Co. show a large collection of their cauldron china, and Messrs. James Macintyre and Co. examples of their manufactures, which they style Taluf and Washington faïence.

Mr. William Ault exhibits a large collection of artistic pottery, called "Ault faïence," and Sir E. H. Elton, Bart., 96 specimens of Elton ware, which is made from clay on the Clevedon estate, and

is said to be the only art pottery produced in Somerset. A selection of Burmantoft's faience is exhibited by the Leeds Fireclay Company, Messrs. Craven, Dunnill, and Co. show various wall decorations, pilasters, plaques, and vases, and Mr. John Phillips sends an exhibit of the productions of the Aller Vale Art Potteries, near Newton Abbott, Devon. These potteries stand on the site of the early pot works of Aller Vale, the later sheds of which, still remaining, are incorporated in the present pottery buildings. The whole of the ware is made of local material, by local labour trained in the technical schools of the Aller Vale villages.

So much space has been taken up by the notice of the pottery and porcelain that little can be spared for a short notice of the glass exhibited in Rooms X., XI., and XII. Messrs. James Powell and Sons exhibit electric light fittings, and four cases of blown glass, illustrating the possibilities of the material with regard to form, colour, and surface decoration. The exhibit of Sowerby's Ellison Glass Works comprises various descriptions of plain, pressed, and blown glass, and Messrs. F. and C. Osler show a fine collection of cut glass. Messrs. T. Webb and Sons (Stourbridge) exhibit sculptured cameo glass, engraved glass, and miscellaneous glass for table use and ornament. Messrs. Chance Brothers exhibit lenses and mirrors for lighthouse illumination, and Messrs. W. Watson and Sons a case illustrating the process of manufacture of photographic lenses. Other exhibitors in the Glass Department are Messrs. Pilkington Brothers; Molineaux, Webb, and Co.; Stevens and Williams; James Green and Nephew; Taylor, Taylor, and Hobson, and George Davidson and Co. Messrs. J. and W. Guthrie, Messrs. Campbell, Smith, and Co., Mr. H. Holiday, Mr. E. Frampton, and Messrs. John Hardman and Co. exhibit specimens of stained glass.

CACAO (*THEOBROMA CACAO*) IN THE SIERRA NEVADA, COLOMBIA.

An important report has been published by the Foreign-office under the title of a "Report on the Cultivation of Cacao, Bananas, and India-rubber in the districts surrounding the Sierra Nevada of Santa Marta." The report in question was furnished to the British Consul at Bogota, and was drawn up by Mr. Thomson, who at one time was superintendent of the Botanical-gardens in Jamaica. Commenting on Mr. Thomson's report, the Consul remarks that, in view of the liberal laws concerning unoccupied lands, it is probable that a company with a moderate capital could find advantageous investments in the district dealt with by Mr. Thomson, where in many places, side by side with the cultures referred to, cattle could profitably be bred for exportation to the West India Islands. The climate in the cacao-growing districts is undoubtedly not suitable for

northern European labour, but there is nothing in the immigration laws to prevent a company from introducing southern European or negro labour. On the slopes of the mountains, where the coffee plant flourishes, the climate is healthy, and plantations might be so selected as to enable the European superintendents to build their houses above the sultry plains, in an agreeable and healthy atmosphere.

Mr. Thomson started from the seaport town of Rio Hacha, at the village of Dibulla. Along and in close proximity to the beach, the vegetation consists to a large extent of cacti and dwarf thorny leguminous trees, which latter at the end of the dry season are mostly devoid of foliage. The direction of Dibulla is almost due west, and the distance about 30 miles. From Rio Hacha a large plain extends some 30 miles towards the eastern extremity of the Sierra Nevada. The western extension of this plain, bounded by the Caribbean Sea and the Sierra Nevada, gradually diminishes in width to some five miles as it approaches Dibulla, and this construction of the plain coincides with the rapid ascent of this system of mountains, that is, from a few hundred feet at its eastern limits to the magnificent summits near Dibulla covered with perpetual snow. Still further westward this narrow plain extends, with the exception of several transverse ridges, about 40 miles towards Santa Marta, where the ramifications of steep mountains project into the sea. The broad Rio Hacha plain, excepting on the lands within a few miles of the mountains, is a comparatively arid region, having a scrubby parched vegetation. Throughout this plain, it may be mentioned, 4,000 tons of divi-divi, the pods of *Casalpinia coriaria*, are collected annually for export besides as much more left on the grounds to rot. On this plain another plant grows wild in great profusion (many millions), namely, Henequen (*Agave rigida*).

From Dibulla, on the seaside, to the base of the Cordillera, the plain ascends to about 150 to 300 feet. It is covered with forest, as are the slopes of the mountains up to 8,000 and 10,000 feet, the exception being some considerable clearings between 3,000 and 8,000 feet in the Arauja Indian district. "In close proximity to the sea the soil is largely composed of sand, but on receding a mile therefrom, a deep loamy soil, on a flat, swampy belt, affords a congenial site for a magnificent forest of palms, an impressive scene of tropical luxuriance. From these palms to the foot of the hills the forest consists chiefly of huge exogenous trees, growing somewhat widely apart for a tropical forest, together with an exceptionally thick undergrowth. Many rivers, and innumerable quebradas, or ravines, connected therewith cross the plain. Here, too, the soil, over which a blue limestone abounds, is extremely rich and fertile. It was here, about two miles from the base of the hills, that I first observed the cacao tree. The important fact with regard to these trees is, that they are of spontaneous growth, and therefore wild cacao, the original

theobroma Cacao. Still nearer the hills, I found the tree dispersed on all sides."

At another point some half-dozen miles westward, while crossing the plain in the direction of the highest summits of the Sierra Nevada, Mr. Thomson found this wild cacao to be a predominating or characteristic plant of the forest undergrowth. A zone of cacao was traversed, not less than eight miles wide, thus distributed on the plain as well as on the lower slopes of the numerous spurs of the mountains, ranging from 300 to 1,300 feet above the sea level. At Don Diego, and still further to the west, a distance of about 40 miles from Dibulla, cacao is found in the forest under precisely the same conditions as those described; and it is stated that all along the base of the Cordillera to Trienta, where the eastern extension of the Sierra Nevada disappears, cacao equally abounds—thus a continuous distribution from beyond Don Diego to Trienta, of about 100 miles. This great cacao zone is entirely uninhabited, and the lands, though obtainable for a few reals (about 2d.) per hectare, are unsought for, their value being wholly unknown. Moreover, the existence of wild cacao seems to have escaped attention. Under the dense shade of the great forest trees, 80 feet high, with trunks five and six feet in diameter, the cacao presents an aspect totally unlike its cultivated congener. The matured cacao trees attain a height of from 35 to 45 feet, with slender trunks devoid of branches to within a few feet of the top, and these trunks are as straight as those of a palm tree. All the pods or fruits, with few exceptions, are borne among the sparsely foliated branches at the summit. Besides the full-grown trees others exist in all stages of growth, hundreds being scattered over a hectare of land. The excessive shade has imparted a weird and ill-proportioned appearance to these trees, many of which, drawn up towards the gleams of light are not thicker than a walking stick, though 20 feet high. Not only have these cacao trees to struggle under the unpropitious shade of gigantic trees, but they have also to contend with numerous minor rivals—an aggregation of species which constitute a tropical undergrowth. The productive capacity of these trees is very variable; some more favourably situated yield as much as 10 lbs. and 12 lbs. of cured cacao, but the great majority yield insignificant returns. It is to be regretted that trees with good crops of fruit are very frequently cut down, this being the easiest means of securing the crop. Among the cacao trees there is no variation whatever in the general form and size of the fruit. The predominating colour is yellow, though pods of a reddish hue are not uncommon. It is interesting to note that the seeds on section are perfectly white. All are undoubtedly one true specific type, a fact of great interest to cacao planters, for apart from the advantages of identity in the process of fermentation, new varieties must eventually evolve either by variation or by cross fertilisation. Several attempts have been made to bring these wild trees to

a state of cultivation. The first efforts in this direction are said to have originated at La Loma many years ago. This attempted cultivation has been confined to the removal of the thick undergrowth which surrounds the cacao tree, and afterwards, at intervals of a year or more, to cutting down the weeds that spring up. The result of these operations, though effecting some improvement in the production of fruit, cannot be considered satisfactory, for the great obstacle to the development of the plant, namely, excessive shade, remains intact. However, by the operations in question, some relief has followed, but the advantage gained is immaterial, when it is remembered that 10,000 full-grown trees yield only 1,200 lbs. of cacao per annum. Though some of these trees yield excellent results, the great majority of them are practically non-productive.

At a distance of about two miles from La Loma, an industrious Frenchman has taken up the reclamation of the wild cacao on the lines adopted on that property. He has during two years cleared the undergrowth over more than 100 hectares, leaving the large forest trees; thus the cacao trees, which formed a part of this undergrowth, have been carefully preserved, and, moreover, one or two experiments are being initiated, such as supplying vacancies when the wild cacao plants were wanting, and topping trees of moderate size, in order to induce them to branch at a convenient height. Notwithstanding these trials, it seems impossible to conceive trees, which have emerged from the condition of forest life, accommodating themselves to the changed habits requisite to bring them into a state of remunerative productiveness, as is the case with systematically cultivated cacao, for cultivated trees from the outset are made to flourish. On the prospects of this undertaking, Mr. Thomson suggested the destruction of some of the large forest trees at given intervals, so as to command more light. With a more abundant admission of light, no doubt some benefit would accrue, but the advantages attendant upon the establishment of scientifically formed plantations would far outweigh that derived from such partial improvements. It is well known that cacao under cultivation is a shade-loving plant, nevertheless, in many instances, protection from the sun is not absolutely necessary; a medium, well-regulated shade is what the cacao planter should carefully establish. In Trinidad, whence more than 20,000,000 lbs. of cacao are exported annually, two species of the genus *Erythrina* are employed for this purpose. These are planted widely apart among the cacao trees, and answer the purpose well. In addition to the attempts at cultivation already referred to, similar trials are being made on a considerable scale at Don Diego and in other parts.

The form of the pod, besides being smaller, is quite distinct from the more elongated types of *criollo* and *forestero*, the most prized varieties under cultivation in Trinidad and Venezuela. Though the pods in the wild type are considerably smaller than those of the

best cultivated forms, it is noteworthy that in the former the seeds are longer, and the pods more economically filled; thus, 10 to 11 pods yield 1 lb. of cured cacao. This result will be best exemplified by the following comparison with Trinidad cacao:—

According to a treatise on cacao cultivation and curing recently issued by the Botanical Department of Trinidad the entire contents (seeds, pulp, &c.) within the foretero pod, as cultivated in that island, when weighed, amount to just about four ounces, and the pulp surrounding the seed, with the placenta, weighs nearly the same as the cleaned kernel. Thus in the Trinidad pod the seeds weighed two ounces, whereas the wild cacao seeds, similarly divested of the extraneous matter, weighed three ounces, the waste matter surrounding the seeds being considerably less than that appertaining to the Trinidad seeds. We have then in the wild cacao not only smaller pods but also an enhanced productive capacity. Besides, the superfluous pulp in the cultivated varieties is a source of inconvenience to the plants. The pulp cannot be removed by washing before fermentation, and even after the decomposition caused by fermentation it is somewhat bad to remove. Under the favourable circumstances referred to, namely, smaller pods, and these more economically filled consequent on the diminution of the waste matter, the wild plant, not only on practical grounds, but also on physiological principles, is capable of yielding larger crops than are obtained from the varieties in cultivation. Hence the importance of the propagation and establishment of plantations of this the original type.

In Trinidad and other cacao-growing countries great importance is attached to fermentation, as this operation imparts the requisite colour and consistency to the article. On the other hand, the method of curing the insignificant crops gathered on the plains of the Sierra Nevada is primitive in the extreme. Sometimes the pods (unopened) are simply put to dry in the shade until the seeds become fit for use; sometimes the seeds are wrapped in large leaves for a week and then dried in the sun; and sometimes the seeds, when extracted from the pods, are placed in a barrel for three days and then dried, the barrel containing the cacao being placed under a roof without side walls. Notwithstanding the elaborate processes which prevail in Trinidad, where special houses and compartments are deemed necessary, the wild cacao, as has been demonstrated by frequent exports of several quintals, holds its ground, for it was classed in the Paris market with the best Caraccas brands.

Trinidad holds the first position among British colonies with regard to cacao production; but recently Ceylon has stolen a march upon the West Indian colony by the realisation of far higher prices, brought about partly by excessive washing and, consequently, thorough removal of the pulp—a method, however, that reduces considerably the weight of the produce—and partly by propagating exclusively from one to two well-defined forms. Anyhow a difference

of 30 per cent. in favour of the Ceylon produce is a remarkable event. The Trinidad planter is not insensible to this achievement on the part of his colonial brother in the East, hence strenuous efforts are being made to improve the quality of this the greatest industry of the island. Lands for cacao cultivation in Ceylon are not available to any great extent, but it is no exaggeration to say that, if the lands occupied by the wild cacao at the Sierra Nevada were obtainable in that colony, such lands would be bought up at once for more than 100 dollars per hectare, about £8 at the present exchange.

The treatise on cacao above referred to says of Trinidad:—“If land can be found on the banks of a stream or river, where there is considerable depth of alluvial deposit, such a position, if capable of being well drained, is a true source of wealth to the cacao planter.” This is tantamount to saying that such ideal sites do not abound. How infinitely superior are the innumerable sites for plantations at the foot of the Sierra Nevada, sites which nature has disclosed.

In former reports by Mr. Thomson, published by the Colombian Government, he strongly advocated the introduction of cacao seeds from Trinidad, with the view of ameliorating the degenerated plantations of the interior. The result of his excursion, he says, has completely nullified his former impressions as to the advisability of importing these seeds. Now the conditions are reversed, the wild cacao being, *par excellence*, the kind for cultivation throughout the Republic. He further says:—“In those countries in which this product has become a staple, the yield per tree hardly averages 1½ lbs. With our wild cacao I feel sure that under careful cultivation that average can be doubled, though in making an estimate of returns I prefer to curtail this prospective average. The cacao planters of Tolima, where millions of pounds are cropped, annually obtain an average of little more than half pound per tree. Hence the replanting of the degenerated fields of the interior as well as the extension of this cultivation with seeds from the Sierra Nevada, is a measure the importance of which cannot be overrated. Arrangements could be made for the acquisition of these precious seeds on a large scale.

“During my sojourn on the Sierra Nevada,” Mr. Thomson continues, “I visited a cultivated field over which a few trees of the wild type were under cultivation. These are old trees growing at the considerable altitude of 3,100 feet above the sea, and they are fully exposed to the sun. The owner assured me that he frequently obtains a crop of 12 pounds of cured cacao from one tree. Unlike their congeners in the forest the cultivated plants are well furnished with branches from the lower part of the trunks. The cacao planter at the coast directs his attention exclusively to the production of this commodity for export, whilst the cacao planter of Tolima and other interior provinces finds a ready market on the spot in consequence of the large domestic consumption. The

latter planter, indeed, commands an abnormally high price owing to the supply not adequately meeting the demand; thus prices actually rule higher than in Europe. The planter at the coast, however, possesses the great advantage of cheap transport to the markets of Europe—an advantage equivalent to about 5s. per arroba, or 25 lbs.

"From the foregoing observations, it will be seen that my convictions are in no way favourable to the irregular and ungenial attempts at cultivation being pursued with the wild cacao in the forest. No doubt some improvement could be effected by cutting down large forest trees at given intervals, but even in this case I cannot anticipate results at all comparable to those obtained from well devised practical methods involving the clearance of the entire forest, so as to form new plantations, and this, too, not with the natural seedlings of the forest, but with specially propagated plants from the wild stock."

The question of selecting a tree to afford shade to the cacao plantations is extremely important. In the earlier stages of the plantations, maize, bananas, &c., suffice for shade. Later on, a tree of rapid growth, with a semi-umbrageous habit, is required. In Colombia there are various species of indigenous caucho or rubber trees which merit the attention of cacao planters. A valuable species easily propagated is said to grow on the banks of the Rio Sinu. This, as well as other kinds of caucho, should be tried. The Zarapia, or Tonquin bean (*Dipteryx odorata*), indigenous in the llanos, is another tree worthy of attention. The establishment of economic shade trees, destined to yield important subsidiary crops, is a matter of the utmost consequence to the progressive development of the cacao enterprise in this country.

Reference has been made to the cultivation of cacao in conjunction or intermixed with the banana. This latter has now become an established industry at Rio Frio, where the plantations are being constantly extended with commendable enthusiasm. Though the industry is in its initial stage, a steamship is despatched fortnightly from Santa Marta with a full cargo comprising from 13,000 to 15,000 bunches. The plantations present a most luxuriant aspect, the result of admirable cultivation, a cultivation in which irrigation plays an important part. Throughout hundreds of hectares of these plantations cacao has been planted contemporaneously with the banana. The overpowering growth of the latter, however, has checked, to some extent, its less exuberant companion, which has consequently suffered. Besides, in the hurry of cropping the banana, cutting them down, &c., the cacao is often injured. The progress made by much of this cacao in the course of four years is hardly greater than should be attained in two years were the plant under congenial circumstances. As a means of alleviating the cacao, the plants should be established in nurseries, and then transplanted several times, until they become vigorous and several feet high, at which stage they

can be safely transferred to the plantation; also, for the general welfare of the cacao, it is recommended that the bananas be set at greater distances apart, so as to ensure more adequate light and free circulation of air.

It will thus be seen that the establishment of the two products conjointly presents some difficulties; both are planted equidistantly. At Rio Frio a modification of the present system would no doubt prove a preventive to the injury sustained by the young cacao tree; at the same time, it must not be assumed that cacao will flourish with its wonted vigour when cultivated conjointly with a plant that is in some degree antagonistic; in other words, the cacao is suppressed in the shadow of a stately mass of great banana leaves. On this account, probably, the cultivation of the banana among cacao should be limited to three years.

INDIAN AND CEYLON TEA CULTIVATION.

Messrs. Gow, Wilson, and Stanton have collected statistics respecting the enormous growth of the Indian and Ceylon tea trade. In the period 1881-93 the total consumption of tea in Great Britain increased 48,000,000 lbs., whereas the use of Indian and Ceylon tea increased 124,000,000 lbs., thus displacing, in 1893, 76,000,000 lbs. more of China tea than in 1881, the increase in the displacement of China tea during this period having been far in excess of the increase in total consumption. This is shown by the following Table:—

	Price, Indian Tea.	Price, Ceylon Tea.	Consumption, Indian.	Consumption, Ceylon.	Consumption, China Tea.	Total Consumption.
	s. d.	s. d.	million lbs.	million lbs.	million lbs.	million lbs.
1881.....	1 5	0 11 ³ / ₄	48	(trifling)	112	160
1882.....	1 3	1 0 ³ / ₄	51	(trifling)	114	165
1883.....	1 2 ¹ / ₂	1 3 ¹ / ₄	58	1	112	171
1884.....	1 1 ³ / ₄	1 2 ³ / ₄	62	2	111	175
1885.....	1 2 ¹ / ₂	1 3 ¹ / ₄	65	3	114	182
1886.....	1 0	1 1 ¹ / ₄	69	6	104	179
1887.....	0 11 ³ / ₄	1 1	83	10	91	184
1888.....	0 10 ³ / ₄	0 11 ³ / ₄	86	18	81	185
1889.....	0 10 ¹ / ₄	0 11 ¹ / ₄	96	29	61	186
1890.....	0 10 ¹ / ₄	0 11	102	34	58	194
1891.....	0 10 ¹ / ₄	0 10	100	51	52	203
1892.....	0 10	0 9 ¹ / ₂	110	63	34	207
1893.....	0 9 ¹ / ₄	0 9	108	64	36	208

So large has been the increase of consumption in Great Britain that 36,000,000 lbs. of China tea only remains to be displaced, and, therefore, the attention of the Indian and Ceylon tea producers is drawn to

foreign markets. The quantity of British grown tea used outside Great Britain in 1890 was about 14,000,000 lbs.; in 1891 about 20,000,000 lbs.; and in 1892 also about 20,000,000 lbs.; nearly one-half of

which was taken by Australasia. This shows the comparatively slow progress made in foreign markets, and the details are fully set forth in the following Table:—

AVERAGE ANNUAL CONSUMPTION OF TEA IN ENGLISH POUNDS.

	1880-84.	Per head of Population.	1885-9.	Per head of Population.	1890.	1891.	1892.
Australia	18,200,000	7·66	21,488,920	7·66	21,253,186	23,262,413	24,009,091
New Zealand.....	3,902,000	7·23	4,337,453	7·19	3,849,105	4,103,190	3,703,716
Tasmania (about)	699,500	5·35	907,035	6·37	977,864	931,207	1,099,188
Great Britain	170,733,600	4·70	183,153,080	4·91	193,949,452	202,396,631	207,055,679
Newfoundland	824,000	4·38	852,073	4·41	871,281	912,600	say 920,000
Canada	16,600,000	3·69	18,849,450	3·90	18,455,475	17,990,630	22,718,181
United States	71,175,314	1·20	79,173,100	1·34	83,494,956	82,395,924	89,610,741
Holland	4,860,373	1·16	5,173,694	1·16	5,615,763	5,907,374	5,876,786
Cape Colony	1,128,500	0·90	1,169,892	0·85	1,464,109	1,167,447	1,885,734
Natal	327,300	0·76	540,832	1·13	520,787	310,682	312,332
Russia	62,408,500	0·61	70,543,866	0·77	73,661,760	67,228,813	71,592,336
Denmark	733,800	0·37	798,306	0·37	752,957	860,782	912,815
Uruguay, 1884	176,930	0·34	203,419	0·29	174,855	126,835	171,745
Argentina, 1883-4....	900,000	0·30	1,118,135	0·28	1,121,960	say 1,200,000	say 1,300,000
Portugal	561,000	0·12	589,136	0·13	642,675	533,051	546,567
Switzerland, 1880 & 2.	292,000	0·10	287,274	0·10	185,158	414,455	431,007
Norway	170,400	0·09	183,082	0·10	196,548	189,169	212,224
Germany.....	3,113,500	0·07	3,975,882	0·08	4,595,340	5,018,508	5,668,688
Morocco (about)	345,000	0·06	744,873	0·10	856,750	1,086,650	1,081,200
Belgium, 1883-4	155,896	0·03	135,379	0·02	127,135	131,169	137,158
Sweden, 1880-3.....	139,250	0·03	198,796	0·04	259,196	282,819	say 290,000
France, 1882	1,029,561	0·03	1,168,317	0·03	1,355,663	1,351,587	1,452,173
Austria-Hung. 1883-4.	739,500	0·02	1,071,925	0·03	1,263,889	1,405,352	1,594,703
Bulgaria, 1884	33,669	0·02	63,008	0·02	123,332	108,345	144,344
Spain, 1884	136,000	0·01	224,720	0·01	201,101	168,971	136,077
Total of all Tea.....	359,385,593		396,951,647		415,970,297	419,514,604	442,862,485
British Grown	53,000,000		94,000,000		150,000,000	170,000,000	193,000,000
China, &c.	306,385,593		302,951,647		265,970,297	249,514,604	249,862,485

ROYAL MINT REPORT.

The Twenty-fourth Annual Report of the Deputy-Master of the Mint for the year 1893 has lately been published, from which it appears that, although falling short of the amount struck in 1892, the coinage of gold in 1893 was again very large, owing to the continued receipt of light coins exchanged under the provisions of the Coinage Act, 1891. The demands for silver coin show an appreciable increase, but there was a falling off in the amount of bronze coin applied for. The transactions of the Mint, in regard to the issue of Imperial currency, are summarised in the following Table, which continues the returns given in former reports:—

	1893.	1892.	Mean of Ten Years, 1883-92.
Gold	£ 9,266,251	£ 13,907,840	£ 4,645,524
Silver.....	1,008,971	849,932	1,039,100
Bronze	46,664	58,556	61,845
Total.....	10,321,886	14,816,328	5,746,569

A new effigy of Her Majesty having been adopted early in the year, the gold coins issued comprised, as is usual on such an occasion, a certain proportion of £5 and £2 pieces.

The demands for colonial coins have been moderate in amount, and the department was able to meet all the applications for such coinages made to it during the year.

The number of good pieces of all denominations struck during the year was 78,380,020, showing a considerable increase on 67,334,847, the number struck in 1892. The value, real or nominal, was, however, owing to the falling off in the amount of the gold coinage, only a little over two-thirds of that of the preceding year, having amounted to £10,789,523 17s. 3d.

The number of coins for the Imperial currency struck during the year was 52,162,020, as against 50,553,847 in 1892; their value was £10,460,864 12s. 11d., the corresponding figure in 1892 having been £14,768,161 3s. 5d.

THE NATIONAL WEALTH OF GERMANY.

In 1886, Dr. Becker, then chief of the German Statistical Bureau, estimated the total wealth of the German people at 175,000,000,000 marks (£8,750,000,000). The United States Commercial Agent at Mayence, in a report to his Government, says that Herr Miguel, the Prussian Minister of Finance, in recent reform projects, has reckoned the wealth of the people of Prussia at 73,800,000,000 marks (£3,690,000,000), of which 29,730,000,000 marks (£1,486,000,000) is stated to be in stocks, bonds, and loans. It is calculated that about 25 per cent. of the wealth of Germany is invested in stocks and bonds, and that this will probably rise to 40 or 50 per cent. in the next generation. Professor Schmoller, a leading authority on economics in Germany, estimates that of the 49,500,000 people who make up the German Empire, 2,500,000 to 4,000,000 are in receipt of incomes from invested capital, and of these about one-half hold public securities. Dr. Becker estimated the annual increase of wealth in the country at 3 per cent., or about 5,000,000,000 marks (£250,000,000), a part of which must arise from enhancement in values, so that 2,500,000,000 marks (£125,000,000) is taken as the actual annual savings of the people. In Prussia, during the last ten years, the deposits in the savings banks are claimed to have increased about 185,000,000 marks (£9,250,000) per annum, and throughout Germany probably 300,000,000 to 400,000,000 marks (£15,000,000 to £20,000,000), from which it is inferred that the German nation is laying up from 2,000,000,000 to 2,500,000,000 marks (£100,000,000 to £125,000,000) annually, one-half of which goes into securities. According to Professor Schmoller, the amount of foreign securities held by the Germans in 1883 was about two-thirds of the amount of home investments, and from 1884 to 1887 it was equal to the latter. Then, during a period of rise in values, it sank to much less, and afterwards fell to one-fourth or one-fifth of the home securities.

IMPORTS OF HAY.

Certain statistics relating to the importation of hay into the United Kingdom have already been printed in the *Journal* (see *ante*, pp. 215, 453). The *Board of Trade Journal* publishes the following Table showing the relative amounts imported in May, 1893, and May, 1894, and the amounts for the first five months of the year compared with the same period in 1893:—

Countries.	Month of May.		Five Months ended 31st May.	
	1894.	1893.	1894.	1893.
	Tons.	Tons.	Tons.	Tons.
Russia, North.....	1,567	—	25,061	—
„ South	—	—	997	—
Sweden	—	—	—	142
Norway	298	120	2,236	434
Denmark	596	447	3,391	1,930
Germany	72	42	1,675	652
Holland	1,133	2,222	7,885	8,385
Belgium	207	15	1,753	110
France	211	111	1,569	628
Spain	—	—	39	—
Italy	—	—	125	—
Turkey, European.....	120	—	490	—
„ Asiatic	—	—	542	—
Algeria	—	—	190	730
Cape of Good Hope.....	—	—	1	—
New Zealand	—	—	22	—
Canada.....	3,902	982	9,860	3,091
Newfoundland	—	—	23	—
United States, Atlantic ...	24,161	5,917	108,369	34,013
Chili	802	—	3,310	—
Argentine Republic	58	381	583	3,606
Total.....	33,127	10,237	168,531	53,721

RECENT EUROPEAN EMIGRATION.

M. Paul Leroy Beaulieu, in a recent issue of the *Economiste Francais*, says it is interesting to devote some attention to the destination of European emigrants since the period at which countries formerly receiving them commenced to experience the effects of financial and other crises. The countries in question are the Argentine Republic, Brazil, Chili, Uruguay, and, to a certain extent, the United States. As regards Australia, which has experienced some troublous times, it will be necessary to wait until next year to discover the effect of the financial crisis upon the volume of immigration constantly flowing to its shores. European emigration appears to be recruited from the inhabitants of three of the chief countries and two of the minor ones. The principal countries are the United Kingdom, Italy, and Germany, and the minor ones, Sweden and Norway. The

United Kingdom keeps her place at the head of the list as regards the number of her emigrants, as appears from certain tabular statements relating to the movement of European emigration during the last seven years, which have lately been prepared by M. Louis Bodio, head of the Italian Statistical Bureau. According to these returns, the number of emigrants from the United Kingdom, that is to say, emigrants of British nationality, and excluding foreigners, who left the ports of the United Kingdom since 1877, attained their maximum in the year 1883, when they amounted to 320,118. The numbers annually leaving the country have been subject to considerable fluctuations. From 1884 to 1886 there was a falling off, but during the period of commercial depression in 1887 and 1888, there was an increase, while from the year 1890 the numbers again commenced to decline. After the United Kingdom it was formerly Germany which supplied the most emigrants, but this country now only comes in the third rank after Italy. In 1881, the volume of German emigration amounted to 210,547; in 1882, the numbers were 193,000; 166,119 in 1883; and 143,586 in 1884. Since the latter year the numbers have decreased, falling to 83,225 in 1886. In 1891, 120,089 German emigrants left the country, and in 1892, 116,458. Italy, since the year 1887, has passed into the second rank of countries of emigration, taking, in this respect, precedence of Germany. Italy is a very prolific country, and its population is already very dense, and whatever may be said of the natural wealth of the country, mountains and marshes take up a considerable portion of the territory, while industries are not in a high state of development, owing to the want of coal, and taxation is heavy. Under these circumstances it is not surprising to find each year a considerable exodus of Italians. The largest number of emigrants from that country to extra European countries was in 1888, when they amounted to 207,795. This number fell to 125,000 in 1889; 115,000 in 1890, and rose, in 1891, to 189,746. The distress in South America, the principal destination of Italian emigrants, still further reduced the current of emigration from Italy to 116,642, in 1892, but during the first six months of 1893 it showed signs of a decided increase, the numbers for the half-year being 78,834, as compared with 49,805 in the corresponding period of 1892. The little Scandinavian races are great emigrants, and they chiefly direct their steps to North America. Swedish emigration attained the figure of 46,556 in 1887, but since then it has fallen to 29,000 in 1889. In 1892, however, the numbers amounted to 33,240. Norwegian emigrants numbered 21,452 in 1888, declining to 10,991 in 1890. In 1892 they numbered 17,049. The Danes furnish an annual contingent of about 10,000 emigrants; Russia, which formerly had a very small current of emigration, now shows a considerable number of persons annually leaving the country. This number has increased from 85,548 in 1890, to 109,451 in 1891, while in 1892 it was 74,682

all to non-European countries. It is stated that a large number of Russians annually migrate to Central Asia, and do not figure in the statistical returns as they escape registration. Two other countries from which formerly the current of emigration was very slow, namely, Austria and Hungary, now figure somewhat prominently in the statistical returns. In 1890, 28,000 Austrians left the country, and 27,000 Hungarians, while in 1892 these numbers had increased to 31,359 and 20,313 respectively. It is interesting to note the emigration from Spain and Portugal, the natives of these countries generally resorting to South America. Spain, in spite of its mineral wealth, is a poor country and its population is sparse, while Portugal, on the other hand, has a dense population in the rich provinces of the north and a sparser population in the poor provinces of the south. When the Argentine Republic, Chili, and Uruguay were prospering, there was a considerable current of Spanish emigration to these countries. From 34,043 in 1886 it rose to 49,283 in 1888, and to 97,719 in 1889. From the latter year it fell off in proportion as the crisis in South America became accentuated. In 1890 it amounted to only 37,025, and to 30,190 in 1892. Portuguese emigration varied between 13,738 in 1886, to 28,945 in 1890. Belgium furnishes from 3,000 to 8,000 emigrants annually to non-European countries; the Netherlands from 3,000 to 9,000; and Switzerland from 5,000 to 8,000. French emigration to countries out of Europe for a long time was almost *nil*, but from 1888, due in great measure to the losses sustained by the ravages of the phylloxera, it took a sudden development. In that year 23,339 persons left the country, and, in 1890, 20,560 persons emigrated. The reconstruction of the French vineyards and the crisis in La Plata put an end to this movement, for in 1891 there were only 6,217 emigrants, and 5,528 in 1892. It appears then, that in the year 1892, which was by no means characterised by the largest volume of emigration, taking the period 1886-1892, Europe sent 700,000 emigrants beyond the seas. The principal current of European emigration is directed towards the United States and Canada. In 1889, the United States received 432,000 emigrants, and Canada 91,000, making a total of 523,000 persons. In the same year 65,161 emigrants landed in Brazil; 261,000 in the Argentine Republic; 27,349 in Uruguay; 1,490 in Paraguay, making in all a total of 355,000. In 1892, the United States received 547,000 emigrants, and the number arriving in Canada is estimated at from 75,000 to 80,000. Emigration to the Argentine Republic has naturally fallen off from its maximum; with 260,909 persons in 1889, it fell successively to 110,594 in 1890, and to 52,092 in 1891. In 1892, however, a slight increase was observable, the numbers increasing to 73,242, while this increase was well maintained in the first half-year of 1893. In Uruguay, the number of arrivals from European countries, which, in 1889, was 27,349, fell to 24,117 in 1890, and to 11,871 in 1892. As regards the

influx of emigrants, Brazil has been subject to considerable fluctuations. For example, in 1888, 131,000 persons arrived in the country; in 1889, 65,000; while, in 1891, the figures exceeded 199,000. This rate, however, was not maintained, as immigration into Brazil fell to 86,213 persons in 1892, a result due to the political crisis and to other causes.

THE RHINE VINTAGE OF 1893.

The United States Commercial Agent at Mayence, in a report upon the Rhine vintage, says that the general opinion formed with respect to it seems to be that the new wine is likely to be similar to that of 1886, ranking a little below the wine of that year in quality. Wines, however, from selected grapes, cabinet wines from the Government vineyards, and those from particularly well-favoured situations, will excel the wines of 1886, and take rank among the best of the century. The must obtained last autumn in the choicest vineyards were remarkably high—the highest on record, and the wines from them will compare favourably with those of any year of the century. A must weight of 100° Oechsle, equal to about 20 per cent. of sugar, has always been considered a high weight for unsorted grapes, and 130° to 140° for selected ones; but, in 1893, the astounding weights of 129·6° Oechsle for unsorted grapes, and 210° for selected ones, were obtained in the domanian vineyards of Marcobrunn and Steinberg. Of such an achievement ever having been met with before, there is no remembrance on record; and as up to the year 1834 there was no sorting out, or *auslesen*, as it is termed, of the finest grapes from the great mass harvested, such results were probably never before realised. In the celebrated year 1868, which is noted for its superb wine, 130° to 140° Oechsle were the highest must weights obtained from selected grapes in the Steinberg vineyard, and it was supposed then that those figures would never be exceeded. The lowest must weight in the better class of vineyards in the Rhinegau last year was reckoned at 84° Oechsle. At Ruedesheim the ordinary must weights ran from 92° to 108° Oechsle; in the Ruedesheimer Berg, selected grapes gave 172°; at Hatlenheim, unsorted grapes gave 90° to 120° Oechsle; selected grapes in the Marcobrunn vineyard, 140° to 210° Oechsle; selected grapes in the Graefenberg vineyard gave 180°; at Hochheim-on-the-Main, 90° to 107° was obtained from unsorted grapes, and 164° to 192° from selected grapes. In the famous Steinberg Crown vineyard, 92° to 122° was what the must weights showed for unselected grapes, and for selected ones 125° to 210°. The acid amounted at Assmannshausen, in the case of red Burgundy grapes, to 6·3 per cent.; in the case of Traminer (a white grape), to 4·5 per cent.; and in the case of Riesling (a white variety, which is the grape mostly cultivated in the Rhinegau), from 6 to 7·5 per cent. Only at Ruedesheim did these grapes reach in part 9·1 per

cent. of acidity. The United States Commercial Agent says, in conclusion, that the must weights obtained will make the wine of 1893 renowned. The summer was hot, and abnormally dry for Germany, which caused an unusual amount of sugar to form in the grapes. What are known as "cabinet" wines will be the best produced during the last 30 years.

THE OTTOMAN TOBACCO INDUSTRY.

A description is given in a Constantinople journal of the central factory of the Ottoman Regie Company at Djubali, which is one of the largest in Europe. It employs about 1,500 person, of whom about 500 are men and boys, and the remainder women and girls. The first objects that strike the eye of the visitor to this vast establishment are the piled bales of leaf tobacco from different parts of the empire, of which a proportion consists of the miniature bales, called *boghichas*, which contain the finest tobacco in the world, known in the trade by the name of *Gheubek*, and produced in the district of Yenidjé. Each of these *ballots* contains from 14 to 16 kilogrammes of leaf tobacco (kilogramme = 2·2 lbs. avoirdupois), perfectly manipulated and packed. Turkey possesses the advantage of being the sole producer of this quality of tobacco, which has a bright gold-coloured leaf and a perfume of its own. Passing through the vestibule, the visitor comes to the sorting-room, where between 160 and 170 hands are employed in assorting the leaves, one by one, for the composition of what is technically called the *harman*, which is the mixture of leaves required to produce one or other of several standard qualities, which are as follows:—Extra, first, second, third, fourth, *Tatli Sert*, Sam-soun, fifth and sixth for officers, and sixth and seventh qualities for soldiers. For each of these grades, a separate *harman* is made, the weight of leaf tobacco assigned to each being noted on a bulletin, which passes to the accountant's department. From the *harman* the tobacco under treatment has its next stage in the cutting-room. This is a vast chamber, manned by about 80 cutters, each one assisted by a boy to feed the cutting machine, and lay the leaves smooth in the hopper, whose business it is to cut the superior qualities down to the *Tatli Sert*. The instrument they employ is a hand-machine called *havan*. Each man cuts from 20 to 30 kilogrammes of tobacco per diem, according to the quality, so that the daily output of this room is from 2,000 to 2,400 kilogrammes—from 4,400 to 5,280 lbs., avoirdupois. The lower qualities of tobacco are cut by machines, on the English system, worked by steam, of which there are twenty-five in the room where that work is carried on. These machines are equal to a daily output of 10,000 kilogrammes. The tobacco, when cut, is lowered by means of lifts worked by steam, into a special *dépôt* for cut tobacco, where it is left for two or three days before being made up into packets in order to ripen. From this *dépôt* is drawn, day by

day, the cut tobacco which is to be made into packets or cigarettes, being sent up as required to the different workrooms. One of these is devoted to the packing of tobacco in cardboard boxes containing 25 grammes, or in boxes, either of tin or cardboard, for quantities of 100, 250, and 500 grammes. The greatest care is exercised in the packing process, which, for the smaller packets, is carried on in four other rooms by young girls celebrated for their dexterity and rapid manipulation, and who turn out from 350,000 to 400,000 packets daily. The tobacco for each packet is weighed out, and when the packets are made, the weight is checked by a controlling machine which automatically throws out any packet of which the weight may be false. The *banderolles* or labels are then pasted on the perfect packets, and when they are dry, the packets are placed in cases, and housed in the *dépôt* for manufactured tobacco. The tubes for cigarettes are made by steam machinery without the use of glue; each machine turns out from 30,000 to 40,000 tubes daily. These tubes are filled in two spacious rooms set apart for hand-made cigarettes, in one of which 200 girls and in the other 60 boys are employed in this work. In a third room the cigarettes are packed in boxes containing 10, 25, 100, 250, or 500 cigarettes each. The daily output of hand-made cigarettes is from 300,000 to 400,000. Cigarettes of the fourth quality are prepared in another room by means of machinery on the French system. Each machine requires only one girl to feed it, her work being merely to place the tobacco on the distributing plate. The machine does all the rest of the work—stamps and cuts the paper, sticks the tubes, fills them, and places them, thousand by thousand, in a box attached to the machine. The *dépôts* of manufactured tobaccos, cigarettes, snuff, and tobacco for chewing, are arranged and ordered under a special system of control which efficiently checks all incomings and outgoings. The factory includes workshops with the necessary machinery and plant for the cutting of paper, for the manufacture of tin and cardboard boxes, for tarring sacks and wrappers, for making and sharpening the knives used in cutting, for making and repairing machines; and besides all these, there are large store-rooms for all kinds of materials, such as paper, cardboard, labels, tin, &c. which serves not only for the central factory, but for those also of the provinces, Smyrna, Samsoun, Salonica, and others of smaller proportions which are established in different parts of the empire. The motive power employed in the factory is derived from three steam-engines, of an aggregate power of 100 horses.

General Notes.

COMMERCIAL MUSEUMS. — A branch of the Turkish Commercial Museum at Constantinople is to be opened in Japan, to which country a large

quantity of goods (carpets, gall-nuts, raisins, Turkish wines and cognacs, &c.) have been sent. The Turkish Consul-General at Barcelona has applied to his Government for the establishment in that town of a Turkish Commercial Museum, in which can be exhibited the different articles of the soil and industry of Turkey.

NIJNI-NOVGOROD EXHIBITION.—The *Gazette de St. Pétersbourg* is quoted by the *Board of Trade Journal* to the effect that the preparatory works of the great Exhibition of 1896 are being actively proceeded with. The Exhibition will be established on the two banks of the Volga. There will be 13 sections on the fair side, on the Oka, alongside the Moscow-Nijni railway; on the town side there will be, besides the military and naval sections, those of horticulture, fisheries, and ways of communication, the latter being installed on the Otkoss slope, known for its fine situation. The two parts of the Exhibition will be connected by an electric railway.

DEVELOPMENT OF THE TELEGRAPH AND TELEPHONE IN SWITZERLAND.—In a report upon the industrial and commercial condition of Switzerland, which has been supplied by the Berne correspondent of the *Economiste Français*, it is stated that on the 31st December, 1893, there were 115 telephone systems working, of which 33 had been opened during the year. There were also 10 in course of construction. At the present time there are 16,929 telephone stations with 14,675 subscribers. The lines are 6,773 kilometres in length (kilometre = .621 of a mile) and the wires 33,266 kilometres. In two years there has been an increase of 54 systems, 4,334 stations, 1,614 kilometres of lines, and 11,908 kilometres of wire. The following is the number of telephone stations in the principal towns:—Geneva, 2,503; Zurich, 2,380; Bale, 1,891; Berne, 1,032; Lausanne, 974; St. Gall, 756; Chaux de Fonds, 555; Lucerne, 555. The number of communications exceeds 1,000,000 in the first three of these towns. For the whole of Switzerland there were at least 10,000,000 messages, or an increase of 20 per cent. in a year. The prosperity of the telephone has by no means checked the development of the telegraph in Switzerland. The number of telegrams sent and received in 1893 exceeded 3,700,000, being 70,000 more than in the preceding year. This development, however, is almost exclusively in connection with international messages and telegrams in transit, and to a very small extent with the messages exchanged in Switzerland. The international telegrams numbered 1,263,000, of which 414,000 were with Germany (increase 15,000); 343,000 with France (decrease 26,000); 155,000 with Italy; 128,000 with Austria, &c. The relations appear to be close between Swiss traders and the East, as there were more than 4,000 messages exchanged with Egypt, 4,300 with India, 2,000 with Turkey in Asia, 1,400 with Japan, 1,000 with China, and several hundreds with the Philippines, the Netherlands Indies, Australia, and New Zealand.

Journal of the Society of Arts.

No. 2,174. VOL. XLII.

FRIDAY, JULY 20, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Proceedings of the Society.

CANTOR LECTURES.

PHOTOMETRY.

BY CAPTAIN W. DE W. ABNEY, C.B., F.R.S.

Lecture I.—Delivered April 2.

The lectures on photometry are not given with the idea that they will be of practical value for the measurement of gas light. There is excellent literature on the subject, part of which I shall have to refer to during my course. What I have undertaken in these lectures is to endeavour to give an idea of the general principles of photometry, almost restricting myself to the scientific aspect of the question. Photometry, in its broadest sense, is the measurement of light, at least, so we must think, from its derivation. Now, the light measured may be light coming from an object, or from a self-luminous body, such as a candle or the sun, or it may be the light transmitted through objects. In the second case, if an appropriate screen be used to receive the light, we are in reality measuring the illuminating power of the source of light, rather than of the light itself. Hence, almost as much depends upon the screen on which the light is received as on the light itself. A screen is usually what is called white, and by white is meant a screen which reflects every colour equally well; but, I would remark that in London the white may become imperceptibly brown, and such colour may interfere materially with accurate results. But the photometry that I am alluding to not only includes the measurement of the

illuminating power of light, but the measurement of the light transmitted through bodies of various kinds, when they are transparent, like plain glass, or translucent, like ground glass or paper. The requirements of the candle-power of gas I shall not enter into, as it is a subject which others than myself are much better fitted to deal with.

We may take it, I think, that the first matter we have to consider is the light we have to use as a standard. Parliament, in its wisdom, in 1860, pronounced its standard of light to be the light of a candle 6 candles to the pound, each burning 120 grains of sperm per hour, and this is at present the only legal standard known in England, though why, in the name of common sense, such a definition has been continued our legislators alone can guess, when it has been proved to be so faulty. The standard of light for France is the Carcel lamp, which is equal to about 9.5 candles. Now, a light from a candle is a very pretty thing theoretically, but practically it is anything but practical, as it has the unhappy knack of burning inaccurately, particularly when one is anxious to shield it from draughts. Heat affects the rapidity of combustion, and if it be confined, and no proper access of air be given it, its light may be most irregular. We have to remember that part of the energy of combustion is taken up by melting the sperm, or wax, or whatever it may be, and if the surrounding air be heated the wax is at a temperature nearer its melting point than it should be when at a normal temperature. When the melting point is attained the liquid is decomposed and the flame results, and there is more liquid to be vapourised and vapour to be improperly consumed than in the normal state.

I show you a trace made by photography of the light from a candle burning under normal conditions. The light was admitted through a slit to sensitive paper, and a fresh portion of paper was continually being exposed. You will now see the irregularity of the burning. Of course, by taking several candles the variation is not so great, but even then you have to be sure that the proximity of the candles to one another does not alter the rate of burning.

An Argand burner, however small, will not, during a long series of experiments, differ 1 per cent. in light value. Here we have a proof of this. This small paraffin lamp was allowed to burn for three hours, and you will see that the band it makes is perfectly uniform in appearance, and when the measurement is

made of the blackness produced by it on the photographic paper, it proves my statement is correct.

The apparatus by which these diagrams were made is a very simple one. It consists of a clockwork arrangement drawing a pulley, which pulley is in connection with a drum, which can rotate on its axis. Round this drum is placed sensitive paper, and a box, with a long slit in it, covers the drum. The light is placed opposite the slit, which is covered by a moveable lathe, in which is an aperture of a convenient width. As the drum moves, this aperture moves across the slit, and so we have a corkscrew band of exposure produced. With some clockwork the motion is regular in its irregularity, and every tooth of the train can be counted on it, by noting the bands of varying exposure, and for this reason the clock was at one time abandoned, and the smooth motion of the sinking of the height in subsiding water was substituted. This gave very good results, but for my purpose the clockwork was sufficient.

The sources of light I have mentioned are what may be called feeble sources of light, and cannot be used when a body is fairly absorptive, if the transmitted light is to be measured. We want in such a case a stronger source of light, and one which is practically constant. Such a source of light we have in the electric arc light. If we project upon the screen an image of the points where the positive pole is slightly behind the negative pole, with a fairly long arc, we become aware that there is a central part, which is higher than any other [shown]. It comes from a depression in the positive pole, and for the last eight years I have been in the habit of using this as a source of light of uniform intensity, and many hundreds of measures have proved it to be so. This, as several years ago I pointed out, was due to the fact that the temperature of this spot was that of the volatilisation of carbon. It is an intense light, and may be taken as 50,000 A.L. per inch of surface, and very useful for a great many purposes, as we shall see as we proceed. Now we call all these lights which I have mentioned white, but it is quite evident that there is white and white if all these be white. I believe myself that Mr. Lovibond's definition of white is a good one, which is the light which is seen in a white fog about midday, and if we compare this light with any other we shall, I think, come back to it as being a very practical white light. Now the electric light is not far

from this quality of light, and as such is very useful in comparing the transparency of objects by what is approximately daylight. We can measure the light of each part of the crater passing through a small hole.

We can at once see the difference between all the ordinary lights by a simple experiment. This box is divided into partitions with tissue in front, and in each partition we have a different source of light—a partial gas jet, an Argand gas-burner, a candle, and a paraffin lamp. It will be noticed that the light enclosed in a chimney is much whiter than those burned in free air, but you will also see that all these lights have various depths of yellowness when compared with the electric light. It is quite evident that even supposing they gave the same illumination, that they are not all fit for standard lights. I take it that a standard light in photometry must always have the same quality of light as well as the same quantity of light. Now we can, by appropriate means, make the electric glow-lamp light of the same visual intervals as a gas jet. The one before us is so, but it is evidently not of the same quality. One of the very best tests that we can make of ascertaining whether any difference in quality exists is to see if, when they are equally strong visually, they give the same photographic results. [An experiment was made with an electric light and an amyl acetate lamp, in which both were made of the same visual intensity, but photographically they differed materially.] You see that the amyl acetate lamp is decidedly the worse photographically.

Perhaps I can show you why this is. I take an incandescent lamp, and cause it to glow: it goes red, to begin with; then I increase the current, it gets yellow, then whiter, and so on, till it is nearly white. I cannot make it as white as the arc light, for the reason that, as the temperature increases, the fusing point of carbon is reached, and that, as I pointed out, is the temperature of the crater of the arc light. These temperatures, however, are subject to different amounts of energy expended upon them; and here I have a diagram, showing how, with an increased energy expenditure on the same filament—that is, with an increased temperature—the different rays of the spectrum are altered in proportion. These diagrams are taken from measures made with a linear thermopile, moved through the spectrum. You will see that the higher the temperature, much more rapidly do the rays of high refrangibility increase.

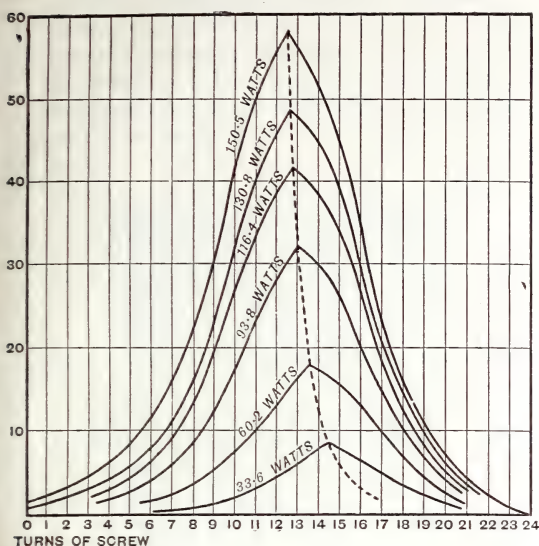


FIG. 1.

The value of the abscissæ in Fig. 1 (in wave lengths) is as follows:—

λ		λ	
1.25	....	5,900	13 14,650
5	....	7,250	17 20,750
9	....	9,900	21 27,500

These numbers apply to both diagrams, and in Fig. 2 the numbers attached to the different curves, are those which are attached to the abscissæ in Fig. 1.

Let me show an experiment. I will balance an electric light against the amyl acetate lamp, and expose a piece of paper to its action. I will increase the temperature and balance again, and expose another portion of the same paper to its influence for the same time. Notice, please, the difference in the two. You will find that the highest temperature filament is much more "photographic." By this means all lights, which are due to the incandescence of solid particles of carbon, can be tested as to quality. Make them visually equal, and then see if they are photographically equal. For my own part, I believe that a knowledge of the photographic value of light is essential in the near future; for I cannot help thinking that there will have to be a registration of photometric values for record, independent of the eye, and this must be by photography.

For this purpose the photographic value, and the visual value of every light used, will have to be known and carefully recorded. We shall see soon how these records can be

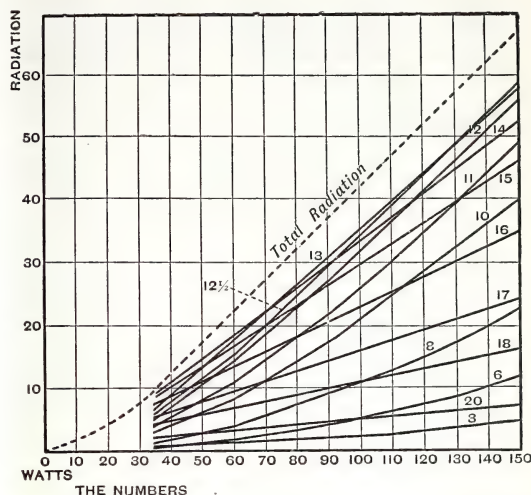


FIG. 2.

utilised, and become of permanent value in themselves, being capable of being measured at any date after being made, and re-measured if required. I throw on the screen the photographic values of a candle, an amyl acetate lamp, a gas jet, a paraffin lamp, and an arc light—all made of the same value as a candle visually [shown]. You will see that they vary enormously, and the scale of opacity below, which was made by exposing different parts of a plate to a steady light for different times, gives us a means of comparing one with the other.

I have said that all lights which are due to solid particles of incandescent carbon can be tested by means of photography, and I have shown you the deposits which certain lights cause on a photographic plate. There can now be but little doubt that a luminous candle flame is as much due to solid incandescent particles as the glow-lamp we have been using. The final proof has been long in abeyance, but I think no doubt now can exist regarding it. First of all, if we examine the spectrum of the luminous part of the flame, we find that it is continuous, though occasionally a bright line of sodium in the orange puts in an appearance, but it is of no account. Now any light which emits a continuous spectrum must be due to a solid or liquid body in a state of incandescence, or to a gas in similar state, but under great pressure. The flame is certainly not liquid, nor is it gaseous under pressure. It seems, therefore, the light must be due to solids, and those solids must be so small

that even a microscope of low power will fail to distinguish them. This fact (if it be a fact) enables us to put the matter to a good test. If we project a beam of light against a cloud of small particles, the rays which are most refracted (the violet and the blue) are violently scattered in all directions, as Lord Rayleigh has shown should be the case theoretically, and the greater the number the more yellow is the light coming through them. There is one peculiarity, however, about these scattered rays, viz., that those which are scattered at right angles to the beam are what are termed polarised in one direction—that is, that if they pass through a Nicol's prism turned in one direction, they become quenched, whilst they will pass through readily if the Nicol be turned in the direction at right angles. You will see what I mean by the scattering by an experiment which I now make.

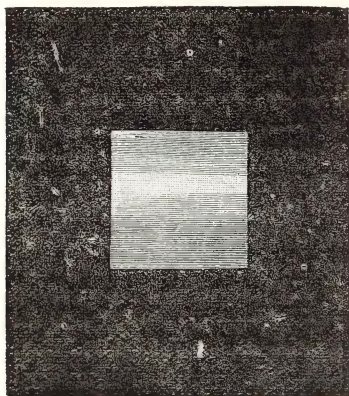


FIG. 3.

If to this clear solution of hyposulphite I add a few drops of hydrochloric acid, it becomes cloudy, owing to precipitation of fine particles of sulphur. I allow a beam of light to pass through the solution before I make the addition to the screen, and then add the HCl. The light becomes yellowish and then reddish, as the number of fine particles increase; that is, the more particles the redder it becomes, and the more light is scattered, as a look at the cell testifies.

By precipitating mastic in water we get the same results. Here is some which has stood two years or more, and while it is turbid the beam of light passes freely through it, but scatters light on each side. Now, if I pass that broad beam of light first through a Nicol's prism, turned in one direction, and then through

the solution, the path of the beam is clearly visible, but if I turned it in a direction at right angles it is at once quenched. Its existence, in the first case, and its absence, in the second, shows that the light, coming at right angles to the beam, is polarised. This you can see for yourselves, at least most of you who sit in the proper direction; but for the sake of those who do not I take two photographs, one with the Nicol turned, so that the polarised light passed, and the other when it was turned, so as to present the beam. You see the result.

Now let us apply this to the small carbon particles. If a beam of intense light, such as that coming from a small image of the sun, be thrown on the flame of a candle, a white beam of sunlight should be seen on the flame, and a beam of white light passing through the flame. Unfortunately, I have not the sun at

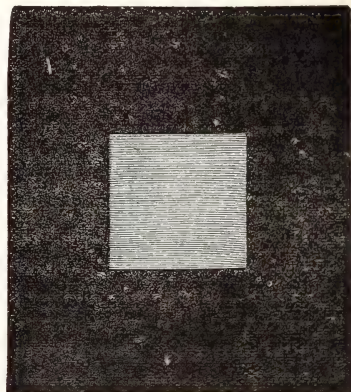


FIG. 4.

my command here to-night, so I cannot show it, but you may take my word for it that such is so. Sir G. Stokes examined this white beam in a position at right angles to its direction, and found, by means of a Nicol's prism, that it was completely polarised; that is, that when the Nicol was turned in one direction, the streak of white light in the flame disappeared altogether. This establishes the fact that the luminous part of the flame is due to small particles, independently of any other proof. It appears to me, therefore, that one is correct in stating that the bright flames are due to measurement carbon. Into the theory of flames I will not further enter at the present time; this is enough for my purpose.

In case there be any doubt amongst you, I will show you some photographs of the phenomena I have taken.

Fig. 5 is a photograph of an Argand gas-flame, on which the rays of the sun, collected by a lens of about 8-inch focus, were concentrated so as to pass along part of the circumference of the cylinder. The Nicol prism was turned in such a direction that the scattered rays would be unaffected in the left-hand

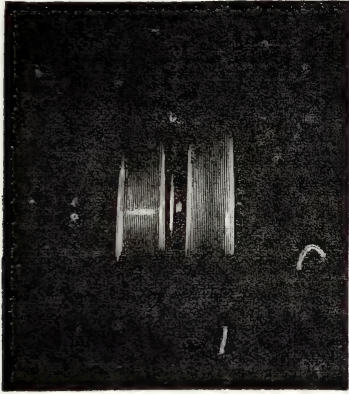


FIG. 5.

photograph, whilst it was turned at right angles to the first direction for the right-hand photograph. In the left-hand figure the track of the beam is readily seen, whereas any trace of it is absent in the right-hand figure. Fig. 6 is the same, but the electric arc light was used in place of the sun. The results are the same.



FIG. 6.

Fig. 7 shows the results when the beam from the electric light is passed through a candle flame. In the one figure a broadish white band is seen, whilst in the other it is absent.

We are now in a position to see why it is some flames are whiter than others. When a chimney is used with gas, for instance, we find that the illumination is whiter—bluer, if

you like the word better. The function of a chimney is to supply air to the flame, ample room being found through interstices to allow as much air as is needed to be drawn up into the chimney. In the case of hollow flames, such as an Argand burner, not only is the air admitted to the outside shell of the flame, but also to the inside. The consequence is that the small particles of carbon are heated to a higher temperature, as they are in the blacksmith's forge by the bellows, and they then emit a whiter heat before they are converted into carbonic acid. When one has a smoky lamp, there is one of two things happening—either the supply of air is insufficient to the chimney, or else the flame is too high and the sudden access of cold air chills down the incandescent carbon particles till they become black, and smoke results. One of the

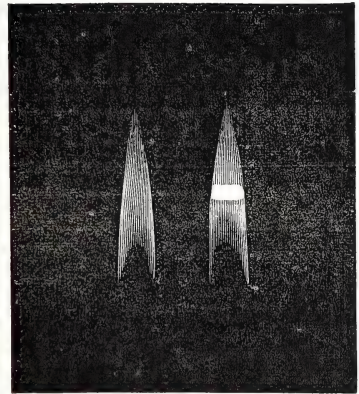


FIG. 7.

most instructive experiments as to the need of air and warmed air to a flame is shown by lighting a paraffin lamp. It is an orange smoky flame, but directly you place the chimney on it the light whitens and the smoke ceases.

I should here like to correct a very common notion which exists regarding the blackening of ceilings by gas flames. As a matter of fact, the carbon in a gas flame ordinarily is totally converted into carbonic acid. It is the ascending current of heated air that catches up the floating motes in the room and dashes them against the ceiling, to which some cling tenaciously, and gradually the blackening is encountered. A friend of mine lately put up the electric light in his house, and placed the glow-lamps close to his ceiling. He was astonished to find that the ceiling above them blackened to an extent which reminded him of gas. It was the current of warm air which

caused the blackening. Similarly, hot-water pipes will do exactly the same thing. Heated air will ascend, and when it ascends it carries the motes and particles with them. In South Kensington Museum, ceilings which adjoin hot-water pipes blacken quicker than where there is gas, the reason being that the volume of heated air is so large.

Miscellaneous.

BORDEAUX EXHIBITION, 1895.

Information has been received from the Foreign-office, through the Science and Art Department, respecting an International Exhibition of Arts, Industries, &c., to be held at Bordeaux in 1895, by the Bordeaux Philomathic Society. The Exhibition will be opened on the 1st May, and England, Belgium, Italy, Portugal, Spain, and Switzerland, are invited to contribute. The French Ambassador in London has written to the Secretary of State for Foreign Affairs to inform him of the arrangements for the Exhibition. This is the thirteenth exhibition that has been held at Bordeaux, and the table of classification is as follows:—Section I., Education; II., Arts (Liberal, Industrial and Decorative; Medicine, Hygiene, &c.); III., Social Sciences; IV., Agriculture, Horticulture; V., Wines and Spirits; VI., Industries (Mineralogical, Mechanical, Chemical, &c.); VII., Habitation (Furniture, Dress, &c.); VIII., Transport, Civil Engineering, and Military Art; IX., Electricity; X., Commerce and Colonies. Some copies of the prospectus and of the classification have been received, and so far as these will extend, a copy can be obtained by any intending exhibitor on application to the Secretary of the Society of Arts, John-street, Adelphi.

ROUEN EXHIBITION, 1896.

Information has also been received from the Foreign-office, through the Science and Art Department, that it has been decided to hold a public Exhibition in Rouen in the year 1896. So far nothing has been settled beyond the date and the site on which it is to be held. This will be the Champ de Mars, upon the northern bank of the river, the most central position in the town. The proposal has been taken up with great unanimity, and the Committee which has been formed is composed of all the most influential men in the town and neighbourhood irrespective of political party. No details are yet settled, but it will be held upon the general lines of the last great Exhibition held at Rouen in 1884, which proved to be financially a complete success. Though this was called an "Exposition Regionale"

and confined in the main to national and more especially Norman products, it was also international in respect to certain classes of articles, and foreign exhibitors took part in it. The Exhibition of 1896 will be arranged on the same lines, and further information will be given when the details are settled.

ROYAL SOCIETY OF NEW SOUTH WALES.

The Royal Society of New South Wales offers its medal and £25 for the best communication (provided it be of sufficient merit) containing the results of original research or observation upon each of the following subjects:—Series XIII. (To be sent in not later than 1st May, 1894.) No. 43.—On the Timbers of New South Wales, with special reference to their fitness for use in construction, manufactures, and other similar purposes. No. 44.—On the Raised Sea-beaches and Kitchen Middens on the Coast of New South Wales. No. 45.—On the Aboriginal Rock Carvings and Paintings in New South Wales. Series XIV.—(To be sent in not later than 1st May, 1895.) No. 46.—On the Silver Ore Deposits of New South Wales. No. 47.—On the Physiological Action of the Poison of any Australian Snake, Spider, or Tick. No. 48.—On the Chemistry of the Australian Gums and Resins. Series XV.—(To be sent in not later than 1st May, 1896.) No. 49.—On the Origin of Multiple Hydatids in Man. No. 50.—On the Occurrence of Precious Stones in New South Wales, with a Description of the Deposits in which they are found. No. 51.—On the Effect of the Australian Climate on the Physical Development of the Australian-born Population.

The competition is in no way confined to members of the Society, nor to residents in Australia, but is open to all, without any restriction whatever, excepting that a prize will not be awarded to a member of the Council for the time being, neither will an award be made for a mere compilation, however meritorious in its way. The communication, to be successful, must be either wholly or in part the result of original observation or research on the part of the contributor.

The Society is fully sensible that the money value of the prize will not repay an investigator for the expenditure of his time and labour, but it is hoped that the honour will be regarded as a sufficient inducement and reward.

The successful papers will be published in the Society's annual volume. Fifty reprint copies will be furnished to the author free of charge.

Competitors are requested to write upon foolscap paper—on one side only. A motto must be used instead of the writer's name, and each paper must be accompanied by a sealed envelope, bearing the motto outside, and containing the writer's name and address inside.

All communications to be addressed to the honorary secretaries, the Society's-house, 5, Elizabeth-street, Sydney.

RUSSIAN SERICULTURE.

Silkworms are principally grown in the Transcaucasus, Turkestan, and, to a considerable extent, in the Transcaspian territory, in the Northern Caucasus, and in the Southern Governments of the empire. It appears, from a report that has recently been issued by the Department of Agriculture of the Russian Ministry of Crown Domains, that in the Transcaucasus silkworms are cultivated by Tartars, Armenians, and Georgians; in Turkestan, by the Sartes; in the Transcaspian regions, by the Tekins; in the North Caucasus, by Cossacks and Armenians; and in the Southern Governments of Russia, by Russian Bulgarians, Moldavians, and Germans. The most destructive disease to which silkworms are subject is pebrine; jaundice is a very common malady among silkworms, but is not fatal; the muscadine occurs sporadically, and that very seldom. The cocoons are often attacked by the larvæ, called *dermestes lardarius*, and, in Transcaucasia, by the ant, *crematogaster subdentata*. The crop of cocoon is in most cases, from 30 to 60 lbs. per ounce of eggs. When the harvest is good, an ounce of eggs will yield from 90 to 120 lbs., and an excellent season's from 150 to 180 lbs. The total quantity of cocoons harvested amounts annually to 1,281,000 pouds (poud = 36 lbs., aroidupois), which are thus distributed:—South Russian Governments, 1,000 pouds; Caucasus and Transcaucasia, 320,000 pouds; and Turkestan, Bokhara, Khiva, and Transcaspia, 960,000 pouds. The prices for raw cocoons fluctuate from 7 to 25 roubles per poud, dependent upon the harvest, species, and quality. The usual price per poud of cocoons is as follows:—For green Japanese variety from 7 to 10 roubles; for European and Bagdad varieties from 13 to 18 roubles. Generally cocoons serve for the home use of the growers, or are unwound by them, and the raw silk sold to dealers. Only in Transcaucasia are the cocoons sold in the crude state. In Bessarabia, in the Government of Kiev, in Western Transcaucasia, in the Transcaspian regions, and in Turkestan, where the cocoons are produce for home use, the silkworm farmers make all sorts of tissues and knitted goods by hand out of the unwound silk. Cocoons in the raw state are sold either to silk factories or to agents or dealers, who dry and then sell them to the manufacturers. The cocoons are either dried in the open air, in sheds, or in garrets. The price of dried cocoons vary from 33 to 50 roubles per poud. The greater part of the cocoons are unwound by the growers themselves. For this work common and primitive instruments are used, and the silk thus produced is coarse, and commands only low prices, as it is only suitable for making cords, for sewing, and for ordinary uses. The prices for such silk fluctuate between 100 and 180 roubles a poud. About 150,000 pouds of cocoons are unwound annually by the European method, principally in Transcaucasia, where 23 steam machines for unwinding silk are at work, producing from 5,000

to 6,000 pouds of silk, sold to the Moscow silk factories, averaging from 250 to 350 roubles per poud. The remains of raw silk, after the unwinding, are not worked up in Russia, but are exported, principally to Marseilles. In Transcaucasia and Turkestan, silk is reeled by the Asiatic method in order to produce orgazine and tram for tissues. In addition there are large machines of Italian and American systems at work in the environs of Moscow, reeling silk of the Chinese, French and Italian descriptions. The greater part of the raw silk produced in Russia is consumed at Moscow and its environs, where all kinds of tissues are manufactured from it, and which are sent all over the empire. Besides the Russian silk, the quantity of which used in Moscow varies between 12,000 and 15,000 pouds, the Moscow mills consume about 40,000 pouds of foreign silk; the rest of the Russian silk is either exported or consumed elsewhere. For improving and developing the silkworm culture, the Government has organised four establishments in Turkestan, the duty of which is to raise healthy and rich silkworms, and to give general instruction in this branch of industry. There is a similar establishment with two divisions, in Tiflis, which is also devoted to the interests of the silkworm trade, and which pays especial attention to the production of the best grades of cocoons, and instructs growers of silkworms in the best methods of culture to be employed in the Caucasus. Moreover the elementary schools of Southern Russia and the Caucasus, in which the cultivation of silkworms is taught, the zemstros and committees belonging to the Moscow and Southern Societies of Rural Economy, all tend to the developement and improvement of the industry. The raising of silkworms is closely identified with the growing of mulberry trees. In Russia two sorts of mulberry trees are grown, the white and the black. The white mulberry tree grows throughout the whole of European Russia, up to the bordering line which passes through St. Petersburg, Moscow, Voronegh, Orenburg, and to the Chinese frontier; also in the Amour regions, in Turkestan, in the Transcaspian territory, and in the Caucasus, except the highlands, where the climate is very severe. In St. Petersburg the mulberry tree winters under straw coverings, and in Moscow it lies unprotected. In Transcaucasia and Turkestan it may be considered a native tree, as it flourishes all over the country, and often grows wild. The black mulberry tree is only cultivated in the Crimea, Transcaucasia, Turkestan, and in the Transcaspian regions. In Transcaucasia and Turkestan there are several species of the white mulberry tree; the black mulberry tree has no varieties, and is known in Turkestan under the name of *shakh-tout*, and in Transcaucasia as *khar tout*. The white mulberry tree is cultivated for its fruit, for the feeding of silkworms, and for many other purposes. The black mulberry tree is grown only for its fruit. Owing to the great importance of the white mulberry tree for the raising of silkworms, the Government has always paid great attention to its cultivation.

THE FAN INDUSTRY OF VALENCIA.

Folding fans, which came from China, were first introduced at the French court in the 17th century, whence they found their way into Spain, becoming in that country so popular that every class of society adopted them in preference to every other kind, such for example, as the Oriental flag fans, or the American palm-leaf fans, which are not much in request in Spain. The United States Consular Agent at Grao says that the fan industry assumed large proportions in Valencia. About the year 1830, factories of some importance were established there, which soon increased their field of work on account of the skilfulness of the workmen and taste of their principals, reaching their height of importance during the years 1865-83, when they found that they could no longer compete with cheaper Japanese fans. On this point, however, manufacturers soon found protection, the Spanish Government raising the import duty on foreign fans. About the same time the manufacture of these fans was divided into separate branches, one devoted exclusively to the framework and the other to mounting the fan, without, however, any detrimental effect upon the industry in general. Of the former branch there exist at present only two firms who cut or saw the frames by machinery, while of the other manufacturers, about twenty-eight of them employ three hundred labourers of both sexes, doing their work by hand exclusively. The frames of the Valencia fans are either of wood, bone, ivory, mother-of-pearl, or tortoiseshell, of which the last three kinds are imported, while the wood employed is mostly olive and Spanish, or else beech wood imported from Austria. The fan itself is made of paper, cloth, silk, lace and feathers. The ornamentation of the paper fans is done in Spain. It may be ordinary print, chromo, woodcut or hand-painting in water-colours. These pictures represent for the most part scenes from Spanish life with a preference for bull fights, also costumes from the different provinces, scenes from popular plays at the theatres and operas, and also public festivals. Those painted on cloth and silk show generally love scenes, ladies, elves, flowers, birds, or insects. While feather fans are imported either from Vienna or Paris, the lace fans are of home manufacture, though the lace for mounting, when not of the old Spanish kind, comes either from Brussels or Nottingham. The number of fans manufactured during the year represents the value of about £15,000, of which £10,000 worth are sold throughout Spain, and £5,000 worth exported to Italy and South America. The proportion of the different qualities of fans made at Valencia is as follows:—Of ordinary fans 50 per cent.; of better or middle-class fans 30 per cent.; of good fans 10 per cent., and of the very best kind 10 per cent. The value of the fans varies from 5s. per gross to 25s. apiece. The wages paid in fan-making are very low—on the average 1s. per day. Even the painters, who often produce very pretty pictures on silk, receive but a scant recompense, yet

strikes have never been known in this industry. Consul Mertens says that the man who may be called the originator of the fan industry in Valencia was M. José Colomina, who for his successful endeavours to establish the industry received the title of Marquis from the Spanish Crown. He possessed, besides his factory, sale-rooms at Seville, Malaga, Barcelona, and two establishments at Madrid. His successors have retired from this enterprise with a considerable fortune.

THE ITALIAN CORAL INDUSTRY.

Genoa, Leghorn, and Naples are the principal ports of Italy at which coral is worked up in establishments of more or less importance. The manufacturers, or rather those who are engaged in the coral working industry, buy it from the fishermen, who obtain it during the summer months, that is to say, from March to October, on the coasts of Sicily and Sardinia. Formerly, the Italian fisherman sought for coral on the French coast, from Nice to Marseilles, and also in Algeria; but, for some years past, the French Government having imposed a tax of 1,000 francs on foreign boats engaged in the coral fishing industry in French waters, this business has showed a decided falling off. Moreover, a large amount of coral has been imported into Italy from Spain, Cape Verde Islands, Japan, and sometimes from Dalmatia, although, as regards the latter place, the fishing for coral has been abandoned for some time past. It appears, from a report recently presented to the Austrian Fishery Society of Trieste by the secretary, Mr. G. Hütterott, that, prior to 1880, the product of the Italian coral fishery was insignificant; for example, a boat engaged in this business during six months of the year on the coast of Sardinia, with a crew of from 10 to 12 men, frequently took no more than 30 kilogrammes of coral (about 66 lbs. avoirdupois); a greater quantity than this was considered an excellent take. In 1880, however, the condition of the coral fishery was entirely changed, and very large quantities were taken, due to the discovery of a coral reef at Sciacca in Sicily, and it was no uncommon thing for the fishermen to obtain in one day as much coral as previously they had been only able to obtain during the whole of the season. In this year the value of the coral fished amounted, according to the statistical returns of the Director-General of the Italian Mercantile Marine, to about 3,000,000 lire (about £120,000). Consequently upon this enormous take there was a decided fall in prices, and moreover the supply of coral exceeded the demand, but of late years there has been a great falling off in the amount fished. A very good description of coral is that found in Sardinian waters, principally in the Straits of Bonifacio, and is much esteemed on account of its good colour. The Sciacca coral is not so highly valued as the above, as the branches are not so large and the colour is not so vivid. On certain reefs the first fishing yields a product of very

good colour, but those that follow produce only a variety of a duller colour. Coral is sold in boxes called *bauli*. The fisherman, or more frequently the owner of the vessels engaged in the industry, himself places it on the market. The value of the raw coral, according to quality, varies from 2 to 200 lire (= 9s. 6d.) per kilogramme. When it is sent to the factory to be worked up it is first of all subjected to a very critical examination, and a selection is then made of the branches according to colour, and as to whether the intention is to cut them up into ornaments or polish the branch itself while leaving it in its natural shape. The greatest part of the branches are cut up into beads. For this work the branches are simply polished with a large file, and then divided by means of another file. The small pieces are passed through a sieve in order that they may be more evenly divided in different sizes. The pieces are perforated in the following manner. The piercer is composed of a needle fixed upon a wooden handle, and which is sharpened upon a stone in such a way that the point becomes flat instead of round. This needle is placed against the piece of coral that is to be perforated, the latter being solidly held in the hollow of a piece of wood, and the instrument is turned by means of a small sling bow twisted round a small wooden handle. The hole is made in a moment. The perforated pieces are then joined together by steel wire, and spread on a table in order that they may be polished by means of a grindstone, the whole length of the wire. This operation has for its object the imparting a uniform size to the pieces of coral held together by the wire. The pieces are then taken off the wire and polished, one after the other, on a round grindstone, but as by reason of their smallness it would be impossible to polish them by hand on the stone, they are taken on the point of a needle fixed into a wooden handle, and then pressed against the stone. By this means it is possible to give to the pieces of coral the desired form, but the operation of polishing is not yet over. The final operation is as follows:—The pieces are placed in a barrel in water, with which pumice-stone is mixed. The barrels used are about the size of ordinary petroleum barrels, having a hole at one of the sides for filling and emptying. In one of these barrels about a hundredweight of coral is placed, together with about double the quantity of pumice-stone, and filled up with water. The barrel is then rapidly twisted round, and the pumice-stone washed out with clean water. Powdered hartshorn is then introduced into the barrel, and the latter is again twisted for some hours. When the powder is finally removed, the coral is found to be beautifully polished. By means of a sieve it is sorted, according to dimensions, and also classed according to colour, and the beads are then strung together. The shape and the quality of the coral varies according to the country to which it is to be exported. Those beads which are pale coloured and round are sold in Western Europe; the darker descriptions find a sale in

Africa and India; the finest and the best coloured is shipped to Japan and China, where the women of the country largely use it as ornaments for their hair.

TEA-GROWING IN THE UNITED STATES.

Her Majesty's Consul at Charleston has lately written a report on an experimental tea farm at Summerville, a suburb of Charleston, which, owing to the climatic conditions of that part of the State of South Carolina, gives promise that great success will attend the cultivation of the plant in question. Consul Rawson Walker says that the first tea plant in that section of the United States was planted by the French botanist, Michaux, in 1804. The publications of the United States Patent-office and the United States Department of Agriculture record the results of many subsequent attempts to inaugurate an American tea industry. It would appear that repeated failure has not checked the ardour of those engaged in these experiments, who constantly enjoy the realisation that their climate is especially favourable to the cultivation of the *Camelia Japonica*, *Azalea Indica*, and have read that the flora of the tea-producing countries of the East finds, to a certain extent, its counterpart in the United States. The little patches, and, in some instances, large gardens, which have resulted from these attempts have produced tea of fine flavour, although very generally devoid of that strength of infusion which appears to constitute a most desirable quality for many tea drinkers. It has been stated, however, that this failure in pungency was largely due to defective curing, and especially to inadequate rolling of the leaf, in consequence of which the cup qualities were not fully developed. So far as is generally known, it remained for the National Department of Agriculture to begin, about ten years ago, the first serious attempt to produce American commercial tea on a scale sufficiently large to arrive at a decisive result, but after a time the gardens which had been established at great expense were abandoned by the Government. The present experiment owes its undertaking to the belief that the previous trials to produce tea in the United States were arrested before reaching definite conclusions, and that more careful cultivation and preparation might produce excellent results. According to the opinion of a firm of tea merchants of the highest reputation in Baltimore, the tea grown on the Summerville estate is equal to the best grade English breakfast tea, and superior to many grades that come from India and China. The samples submitted were all of one quality and character, black, crisp, and well scented. It makes a strong beverage, and this quality is said to be due to its treatment in fermentation and curing, and it is the opinion of this firm that perfected methods of curing the American product will produce tea similar to the various kinds that come from India and China.

An expert on tea planting gives the following estimate of the probable yield per acre on flat land, good soil, in a good tea climate, which Summerville in South Carolina is considered to be. This is with hybrid plants, if really high cultivation and liberal manuring is carried out. First and second year, *nil*; third year 40 lbs.; fourth, 160 lbs.; fifth, 320 lbs.; sixth, 400 lbs.; seventh, 480 lbs.; eighth, 560 lbs.; ninth, 600 lbs.; and the tenth year, 640 lbs. The announcement of the revival of tea experiments in the United States has excited the liveliest interest and assistance for the undertaking. The United States Department of Agriculture has manifested a deep concern in the project, and has borne a considerable part of the expenditure for procuring consignments of tea seed from Asia. The Department of State has also issued orders to its Consuls at the tea ports to obtain samples, and the foreign representatives of the United States Government have spared no efforts to secure the best quality of seed.

CHINESE JEWELLERY.

The first thing that attracts the attention of the European on landing at Shanghai and Hong Kong is the quaintness and the quantity of jewellery worn by Chinese women in their hair. It varies from place to place, so that a careful student, after a little experience, can tell where a woman comes from by simply looking at the ornaments on her head. There are first the purely decorative pins, the finest kinds of which are made of gold. Below these are silver ones; and below these, for the poorer classes, are brass ones tipped with either of the precious metals. In addition to metal, ivory, ebony, horn, tortoiseshell, bamboo, and celluloid are largely employed for the same purpose. The head of the pin discloses the wealth of the wearer. The wife of the Viceroy of Foekin has a pin, the head of which is a large ruby. Pins of this sort are worth immense sums. In this class come a large number of pins, whose heads are emeralds, pearls, jade pieces, gold balls or figures, and silver designs. In another class the pin terminates in a cluster of some sort, and there seems no limit to the designer in this field. The cluster may be seven jade stars, suspended or supported by fine wires, it may be a group of blue cat's eyes, representing a bunch of grapes, a row of pearls swinging from minute chains, a knot of exquisitely coloured tiny porcelain flowers and fruits, turquoises carved into violets, a *bouttonnière* of buttercups in filmy gold eaves, &c. In a third class the shank and head are separate, and this keeps the latter in perpetual motion. This fashion, however, is rarely seen outside of Fuchan and Amoy. In addition to the other styles referred to, the heads are made also of flake jade, cut to represent long leaves and similar shapes, porcelain butterflies, gold and silver moths and dragon flies, little birds in metal, vines, &c. The hairpin in the

East, unlike that in the West, is generally silver or gold. It is a thin bar, slightly flattened, waved and corrugated, and usually from six to eight inches long. Its owner bends it according to the style in which she dresses her hair. The gold and silversmiths make special alloys for hairpins. Ordinary pins would break after so many bendings and unbendings as the Chinese pins are subjected to, but the latter lasts a lifetime. A curious instrument possessed by every one in China above the extremely poor is the tongue scraper. They may or may not have brushes, but they are sure to have a tongue scraper. This scraper is a ribbon of silver or gold with a ring at one end, by which it is suspended when desired. The cheapest are of plain metal; more expensive ones are engraved, while a few are jewelled at either end. Like hairpins, they are sold by weight, plus a small charge for workmanship. Thumb rings are very common in the East. These are often made of precious metal, ivory, jet, and precious stones, but generally they are of fine jade. The cavity is not cylindrical, but swells out at the base and middle. This enables the owner to wear it lower down, and also prevents it slipping. The jade is usually polished, but may be engraved or carved in intaglio or relief. The refined classes use jade exclusively, and as precious a variety as their purses will permit, but some of the lower classes wear imitations, which are made of glass or porcelain, coloured with lead or iron oxide. One variety, which is made by enamelling iron, is remarkably strong and durable, and corresponds to the "knuckle duster." The thumb ring came into vogue in the time of the Three Kingdoms, during the *régime* of the famous general Kwang-Ti. He used a bow, and to increase the accuracy of his aim, substituted a heavy bamboo thumb ring for the glove usually worn by archers. His example was followed by his bowmen, until the practice became general. On his rise to power his admirers presented him with a jade ring of great value, which he substituted for the bamboo one. His brother, the reigning monarch, adopted the custom out of compliment to the great warrior, and thus introduced the fashion into civilised society. Luck pieces are frequently carried. They are the Chinese character for the word *fook*, meaning good luck or happiness, and are made from jade or the precious metals. These are worn as watch chains, pendants on necklaces, bracelets, and rings, ornaments to tobacco pouches and spectacle cases, or as a decoration pure and simple. Jade buckles form another jewel of great value. These are nearly always handsome carvings, and are fastened to the belt, which they are supposed to clasp, and they are considered to be a necessary part of a gentleman's outfit. Wealthy mandarins have a considerable number of these articles of a very expensive kind. The present Taotai of Amoy has a jade buckle valued at a thousand dollars. It represents two interlaced dragons, and is said to be four centuries old. In Canton these articles are the subject of a special industry.

THE WOOLLEN INDUSTRIES OF PERSIA.

Her Majesty's Consul at Ispahan, who has recently reported upon a visit paid to Yezd, Kerman, Shiraz, and Sultanabad, says that at Kerman a considerable trade is carried on in the weaving of *shal*, carpets, and the making of *namads*, or felts. In all these industries the chief ingredients is wool. The *shal* is a woollen cloth, which is made up into lengths of from three to five yards, with a width of about 42 inches, of various tints and thicknesses. It is used for coats and cloaks, and costs from 20 to 50 krans each (kran = 6d). Better qualities are embroidered in various designs and colours, and form very lovely articles, being used for coverlets, table cloths, and wrappers. This is known as *Tirmah*. A further development comes out in the shape of the shawl, which is so widely renowned, and is only surpassed by the celebrated ones of Cashmere. These shawls are made in rooms specially built for the purpose, low, dark, and without ventilation. A room will contain some four to ten looms, according to its capacity. The length of a shawl is about 10 feet 6 inches by 3 feet 6 inches in width. The loom is perpendicular, and the pattern side is away from the workpeople, of whom three are employed on each shawl, the one in the centre directing the other what colours to work in from memory. The procedure generally, in making shawls and carpets, is very similar, except that in the shawl the ends of the wool are not cut off, but are turned in, and remain to be carried on. Shawls are made varying in price from 30 to 1,000 krans. The latter are almost entirely taken up by the Government and rich natives, while the cheaper ones go to the various towns in Persia; the largest demand comes from Constantinople, for which place special shapes and designs are worked. A small quantity also finds its way into Russia and the Khanates. In Persia, the carpets of Kerman have even a higher reputation than the shawls, and are more esteemed than any other carpets made in the country. They are celebrated for the closeness of their weaving, excellence of design, old patterns being almost generally adhered to, and the purity and fastness of the colours. As a rule, they are made small, generally about 6 feet 6 inches by 4 feet. Larger kinds can be made, but they are very expensive; a very ordinary carpet of the above size will cost about £4, but really good ones sometimes fetch £75 the pair. They are generally so made and sold. In carpet weaving, the number of operatives is regulated according to the width of the carpet, one being stationed at every half-yard (Persian yard = 21 inches). In the centre is the director, or *Khalifah* (bishop), as he is called. The *Khalifah* is generally a grown-up man, or a lad of about 16 years of age, whilst the operatives are but children, varying in age from 4 to 14. The pattern or design of the carpet is drawn out in colours on sectional paper, and the colours and numbers of stitches of each colour are called out by the *Khalifah*

to the operatives from it. The looms in Kerman are placed up and down in perpendicular, whilst in the districts and among the nomads they are placed horizontally. The work is commenced at the bottom, and as the carpet is woven, it is wound gradually over the lower beam, and the work is thus kept always at about the same level. These carpets are generally woven square, whilst in the districts, owing apparently to their using the horizontal method, the cotton threads of the warp are not held at a sufficient tension, and, therefore the carpet comes out irregular in shape. The warp of these carpets is made of cotton twist, which is imported either from England or Bombay. The woof is made from the wool or kurk of the Kerman sheep or goat, and dyed by the wearers themselves. Should, however, a silk carpet be made, both warp and woof are of silk. Kurk is a speciality of Kerman. It is the under wool of the young animal which is shorn in the early spring. If left too late it casts its wool, and it becomes coarse and valueless. The hair of the goat and wool of the sheep are used separately, never, if possible, are they used together in making the same carpet. *Namads*, or felts, are made in several places in Persia, but those of Kerman are the most esteemed. They are beautifully soft, and yet wear well. As a rule, they have a pretty carpet design in them in various colours, which is very effective. In other places the design is only in white and red. The size of the *namad*, or felt, being determined, a piece of matting somewhat larger is taken, and on it are placed, according to the ideas of the workman, small pieces of coloured wool, which, although apparently placed without method, yet, at the end, develop into a pretty and graceful design. Over this is laid a piece of thin fine felt. The matting and felt are then well saturated with a strong soap lather. They are then tightly rolled up together, and with alternative pressure from his elbows and knees, the roll is well-worked by the man until the design, which, in the process, loses none of its former crispness of outline, is thoroughly pressed into and consolidated with the felt. This, again, is placed over another piece of felt, rolled up with it, served with soap lather and treated as above, and so on until the required thickness of felt is obtained. A good felt will take five days to make, and, if about ten feet by five in size, can be bought for £2. Kerman and the surrounding districts have the reputation of making the best felts in Persia.

MANUFACTURE OF OIL AND FOOD FROM PEANUTS IN GERMANY.

The ordinary peanut or earth-nut is the seed vessel and seed of the *Arachis hypogæa*, and grows in several of the Southern States of America and in Brazil, the East Indies, and on the east and west coasts of Africa. In 1891, 15,762 tons of peanuts

were imported into Germany; in 1892, 13,158 tons; and in 1893, 20,973 tons. This large supply of imported peanuts is used for the manufacture of oil, and is consumed by about 27 factories, which are situated in various parts of Germany, some of the principal being at Hamburg, Mannheim, and at Heilbroun in Wurtemberg. Peanuts vary greatly in value according to the quantity and, still more, the qualities of oil which they contain. The finest and most valuable come from the valley of the Senegal, while the lowest grades come from Madras. The nuts from West Africa and from America arrive usually in the shell, but in East Africa and in India they are often threshed out by machinery, and the seed only exported. The shells of dried peanuts constitute 23 per cent. of their weight, and are used in Germany as material for certain kinds of paper, or are ground up as food for cattle. At the oil-mills the kernels are ground or crushed and submitted to three successive pressings. The first pressing expels about 40 per cent. of the oil; the second, 4 per cent.; and the third pressing, from 2 to 3 per cent. of the remainder. Cold pressed oil of the first pressing from African or the best American peanuts is used in Germany as salad oil, and for various culinary purposes. The last pressing from African and American nuts is not used directly for food, but is consumed in the manufacture of soap and for various other purposes, among which is included the "fattening" of oleo-margarine. The most important secondary product of peanut oil manufacture is the oil-cake or meal, which remains after the oil has been, as far as practicable, extracted by pressure. This sells for about £6 10s. per ton, and until within a year or two ago has been used in Germany exclusively as food for cattle, sheep, and to some extent for horses. Under chemical analysis peanut oil shows such extraordinary richness in nitrogenous elements that the Germans have seized upon it as an obvious source of cheap and highly concentrated material for human food, adaptable not only to army and navy rations, but of timely and great value to the peasant and industrial classes, which have suffered from a long and nearly exclusive diet of bread and potatoes, unmixed with a due proportion of nitrogenous animal food. This has led to a series of experiments, and to the invention by Dr. Nördlinger, of Bockenheim, of a series of preparations from peanut meal, which seem destined to play an important part in the future food economy of the German people. The problem was to convert a waste material—the secondary product of oil manufacture—into a palatable, nutritious, and wholesome form of human food, cheaper in cost than the same equivalents of nutrition could be supplied in any other form, and susceptible of simple and easy preparation by any cook of ordinary intelligence. The principal forms in which oil-cake from peanuts is prepared are represented by the following—peanut grits—which make a coarse meal dried, purified, bolted and packed in papier maché boxes, containing one German pound each. In this

form it is used for soups, cakes, and is cooked as a vegetable. Peanut flour is similar to the above, except that the meal is ground and bolted like ordinary flour. Peanut biscuits are dry, light, and highly palatable, and diabetic chocolate biscuits, which are also made from peanuts, are said to be highly recommended for persons suffering from diabetes. These articles have been in the market and in experimental use for rather more than a year, and as articles of food, have been warmly praised by many German chemists of the highest standing.

General Notes.

LÉOPOL EXHIBITION.—A national Polish Exhibition is arranged to be held this year at Léopol, the principal town of the Austrian province of Galicia. The chief objects exhibited will be in the Department of Agriculture. Previous exhibitions were held at Léopol in 1877, and Cracow in 1887.

LUXEMBURG WORK EXHIBITION.—Luxemburg is not larger than an English county, but her industries are important. Were it not for the accident of the rich and extensive iron ore deposits which have given rise to a remarkably large iron production, there are several industries, which, if not thrown into the shade by the iron manufacture, would be regarded as relatively important. These are chiefly the production of leather gloves, earthenware, pottery, drain-pipes, and machine-knitted fabrics, while the gardening, brewing, and distillery industries are flourishing. With the double object of making known the articles manufactured in Luxemburg, with her power of production, and opening up new markets on the one hand, and on the other of vulgarising the use in the country of small motors, machine-tools, and labour-saving appliances generally, the Government has organised an Exposition du Travail, to open in Luxemburg City on the 20th of August next. While the exhibition of manufactured articles is limited to those produced chiefly if not entirely into the country, raw and semi-raw materials, motors, machine-tools, and labour-saving appliances are admissible from other countries. The first group includes finished products in metal, glass, stone, earth, or wood; the second, raw and semi-raw materials, such as stone, earths, lime, plaster, wood, and leather; the third, model workshops; the fourth, steam, gas, petroleum, benzine, water, air, and electric motors; the fifth, tools and machine-tools for working metal, wood, stone, and earth; the sixth, pumps, ventilators, presses, lifting appliances, electric machines and installations, and also arrangements for preventing accidents; and the seventh, technical and industrial schools, while the library will include technical literature. Further information may be obtained from M. J. P. Henrion, Conseiller du Gouvernement, Luxemburg.

Journal of the Society of Arts.

No. 2,175. VOL. XLII.

FRIDAY, JULY 27, 1894.

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Notices.

PRACTICAL EXAMINATIONS IN MUSIC.

The practical examinations in Music were not concluded this year in time for the results to be included, as usual, in the Report of the Council. There were 379 candidates, an increase of 67 over last year, and considerably the highest number who have presented themselves: 18 candidates took up two subjects, so that there were 397 examinations; 92 first-class certificates were awarded, and 209 second-class; 96 were failures. Sixteen medals were awarded to those candidates who obtained full marks. The following were the subjects:—Piano, organ, violin, violoncello, mandolin, and singing. Sir Joseph Barnby and Mr. W. G. McNaught again acted as examiners.

Proceedings of the Society.

CANTOR LECTURES.

PHOTOMETRY.

BY CAPTAIN W. DE W. ABNEY, C.B., F.R.S.

LECTURE II.—*Delivered April 9, 1894.*

I omitted, from want of space, to say in my last lecture that the fact that a flame viewed end on is from 10 to 35 per cent. less luminous than when viewed sideways. Fig. 1 gives a measurement if taken with a flame at different angles to the screen according to Mr. Dibdin. The variations in the light of a burning candle has been shown you, and I think that for

scientific working it must be dismissed as unworthy of serious consideration. There are only three what I may call feeble light standards which I shall refer to, viz., the amylacetate lamp, due to Hefner Alteneck; the pentane illuminant, and the ether illuminant. I put the amylacetate lamp first

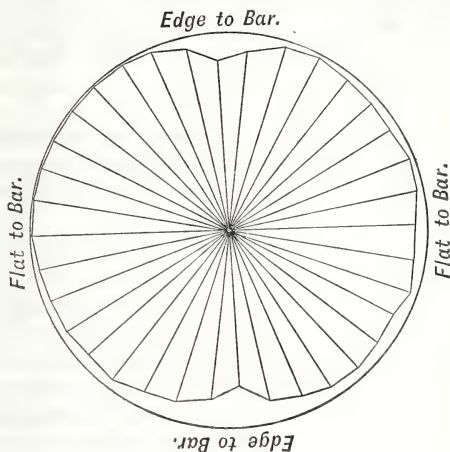


FIG. 1.

not because of its superiority, but because it requires such little manipulation. This is a lamp which is a great favourite of mine because it is so accordant in its results. It consists of a tube of German silver, 8 mm. in diameter, and 25 mm. high. The flame is 40 millimetres high, and when it has been burnt

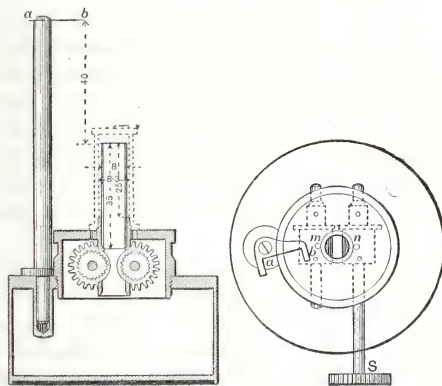


FIG. 2.

for five minutes the flame remains of a constant height. It burns amylacetate, but it is not necessary to use this compound, as any similar one will consume as well. Hefner Alteneck gives a Table of the results of the different compounds and their comparative luminosities:—

	Constitution.	Per cent. of carbon.	Boiling point.	Intensity of light.	Time for the combustion of 1 gramme of the substance.	Carbon consumed in 100 seconds.
Valerate of Amyl.....	$C_{10} H_{20} O_2$	69.7	C. 195°	1.03	430	0.162
Acetate of Amyl	$C_7 H_{14} O_2$	64.6	138°	1.00	388	0.166
Formiate of Amyl.....	$C_6 H_{12} O_2$	62.1	122°	1.01	372	0.163
Acetate of Isobutyl	$C_6 H_{12} O_2$	62.1	116°	0.99	373	0.163
Formiate of Isobutyl	$C_5 H_{10} O_2$	58.8	98°	0.97	355	0.166

The drawback to this lamp, as originally constructed, is that the metal takes a green deposit, which is tiresome; if it be plated with silver, this disappears.

Dibdin's pentane Argand, which burns pentane, is the next one to refer to, and is the lamp which appears to me most perfectly to utilise the pentane, employed as an illuminant, in a simple method. Pentane is a hydrocarbon of the paraffin series, but is not perfectly pure at all times. The illuminant is air passed over a carburetter containing the pentane. The height of the flame is 3 inches, $\frac{7}{10}$ ths of which are cut off by a screen at the top. By these means a standard flame is obtained, which is equal to 10 candles. The great point in this is that the height of the flame does not affect the result, at least it does not to the eye. Temperature has no effect on the result, as Mr. Dibdin has thoroughly tried.

The next standard is a very simple one, introduced by Mr. Dibdin more especially for photographic purposes; ether, instead of pentane, is burnt in a pentane lamp, and gives a very fine light. Photographs taken with these two lights at different heights of flame, but of the same visual intensity, do not give quite the same photographic effect, so that there is a deviation from the definition of perfect standard.

We have seen what kind of a light we must use for photometry as to quality and quantity. Now we come to photometers. The photometry we will first consider is the comparison of two lights together. How are we to compare two lights? There is one evident way, and that is to place side by side two white surfaces which are illuminated by the two lights. This is the principle of Rumford's photometer and nothing else. We are usually told that it is the method of shadows—the comparison of shadows one with the other. Now it is nothing of the kind, it is really the illumination of a surface by two distinct lights,

the one illumination being not interfered with by the other, and this is secured by making one light cast a shadow of a rod on the screen, which is illuminated by the other, and this last light to cast a shadow of the same rod at a different place, which is illuminated by the first light. These two illuminated surfaces can be made to touch by moving the rod or the angle of the light, and by various plans these can be equalised in brightness. No less a distinguished authority on photometry than Mr. Dibdin, in an excellent book he has written, says, although this method has certain advantages, "the method is one which few practical photometrists of the present day would venture to adopt." Well, I am a tolerably practical photometrist myself, and I must confess I prefer it to any other kind of photometry, as it is simple, and very few errors can creep in if one is ordinarily careful, which is more than can be said of some others, as we shall see. One error that may be met with is that if the lights make a great angle with each other, and if the screen is not placed at right angles to the line bisecting the angle, an error may creep in.

Let me show you this experimentally, and this experiment really demonstrates another mode of photometry.

This white cube is placed between two lights, one of the right angles of the cube being towards you. I place a square aperture in front, so that it is bisected by the edge. The cube is rotated round that edge as a centre, till the two sides appear equally illuminated. The reason of the equality of illumination is quite plain. It is because the side nearest the light is skewed at a greater angle than the other to it. If we have a diagram, we shall see why this is. In Fig. 3 (p. 749) AB and BA are the two sides of the cube illuminated by rays R and R . It is evident that the side AB will not receive so many rays as BC , in fact, the amounts are measured by $p q$ and $m n$. If the lights are unequal, of course when the

intensity of the one multiplied by $p q$ is equal to the intensity of the other multiplied by $m n$ the two will equal. The intensities, where a balance is struck, is found by taking the cosines of the angles through which the cube is turned.

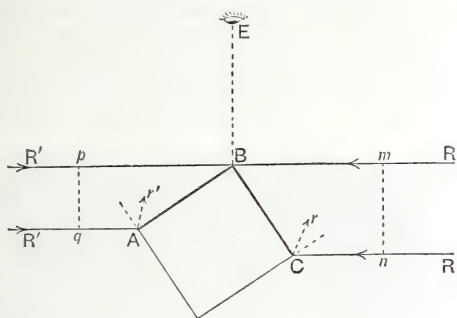


FIG. 3.

We now see that light illuminating a surface varies as the cosine of the angle through which it is turned. If it be turned 5° more towards one light than the other it is evident that we shall get a variation. The amount would be as 1 to '996, or an error of $\frac{4}{1000}$, or $\frac{1}{250}$. If it were 10° it would be 1 to '984, or $\frac{16}{8000}$ or $\frac{1}{500}$ part, which would be appreciable.

There is still one more error which might be felt, and that is that the eye receives more light when the angle which the screen makes with the eye and the source of light is greater than a right angle (see r and r' in Fig. 3). This must always be the case, but what may be called the difference in the specular reflection is so small for ordinary angles, that it is of the same order as that given for the wrong placing of the screen, and becomes practically negligible.

For great accuracy the illuminated shadows should touch, and if the lights be not too broad, there is no difficulty in causing this to be done; sometimes, however, a white line or a black line will separate the two owing to the penumbra of the shadows, and then making the illuminations of the two strips equal becomes more difficult. As the black line has greater contrast to the two illuminated surfaces than the white line has; the former is the worst kind of line to put up with.

The next method that is adopted is what is known as the Bunsen method. It consists of equalising the brightness of a greased spot in the centre of a paper disc, or its total disappearance. The principle on which this is based is the translucence of the spot. If as much light goes through the spot (if perfectly

made) from one light as goes through from the other, the spot is equally illuminated throughout its thickness, and appears the same whiteness as the paper. If it be greater on one side it will appear dark on one side, and lighter on the other. It is evident that with such a method every suspicion of stray light must be rigidly excluded, unless it be exactly the same on both sides of the disc, and only that coming directly from the sources of light utilised. Light reflected from the sides or bars will give fatal results as far as accuracy is concerned. I have met with some instruments in which reflections seem to have been encouraged rather than allayed. To my mind the method should not be accepted except in the hands of those who are thoroughly practical and scientific. I show the design of a Letheby photometer, kindly lent me by Mr. Sugg. [The instrument itself was in the lecture-room, through Mr. Sugg's goodwill.] The grease spot is viewed on both sides by inclined mirrors, and when the grease spot disappears on both sides, or at all events appears to equally dim on each side, the light illuminating the spot may be said to be equal.

There is one thing to be noted, and that is that very much depends upon the kind and amount of grease, and the kind of paper, employed. I have made a good many grease spots in my day, and I have found the sensitiveness of the method vary considerably according to the attention paid to these details, but I have abandoned the method in my laboratory, except under special circumstances, in favour of the old Rumford method.

Mr. Dibdin, in his work, says:—

"When first setting up a disc for use, special experimental readings should be taken; and if any material difference is found between the indications when one side or the other is turned towards the standard flame, it should unhesitatingly be rejected, as no amount of after allowance can compensate for the trouble and doubt arising from contradictory results. The disc should be clean and perfectly free from scratches or other markings of any kind; it is but sorry economy to work with a defective instrument. The Gas Referees went so far, a short time back, as to run a new disc, to be used every week. As, however, a good disc, when taken care of, will last much longer than that period, the point has not been insisted upon; but that is no excuse for the continued use of a defective one, which should be instantly destroyed as soon as detected."

We see from this that a disc photometer is open to a very grave objection, and it is for this, if for no other reason, that I prefer the

Rumford system, where there is no liability to err on this matter. A modification of the Rumford method of shadows is that employed by Prof. V. Harcourt. He casts his shadows on ordinary printing paper, rendered partially translucent by a wash of spermacetti dissolved in petroleum. Instead of a rod, and about three-quarters of an inch from the paper, he places a brass screen, having two rectangular apertures cut in it exactly their own breadth apart. The two lights are placed at equal angles on each side of the line perpendicular to the screen, and the illuminated shadows are caused to just touch one another. It will be noticed

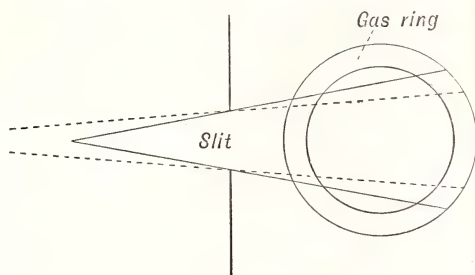


FIG. 4.

that really there are four shadows illuminated, one from one light being touched by the other two, and the fourth falling on an opaque or black space. A great advantage of this plan is that they are looked at from the back of the screen, no rod being between the eye and the screen. If two lights of approximately the same colour are looked at, the fact that the light has to traverse the paper is of no moment, though, when coloured lights have to be compressed, there is a danger of absorption

slightly altering the values that should be obtained.

Before quitting the subject of the Bunsen method, I ought to mention that in photometry, for the grease spot is sometimes substituted a star of thin paper, sandwiched between thicker paper; that is known as a Leeson disc, and has been much improved by Mr. Dibdin.

Methven proposed to use a slit placed in front of an Argand gas-jet as a regulator, if I may call it so, of the quantity of light issuing

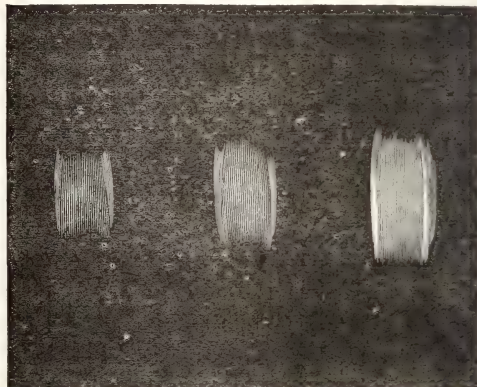


FIG. 5.

on to the grease spot. This appears at first sight an admirable arrangement, and it would answer well if the grease spot were always kept at the same distance from the source of light, but when it is moved, an error, though it may be very small, must be introduced. An Argand flame is practically a hollow cylinder of light, of a certain thickness. (Fig. 4.) As you approach the light the section of the cylinder varies,

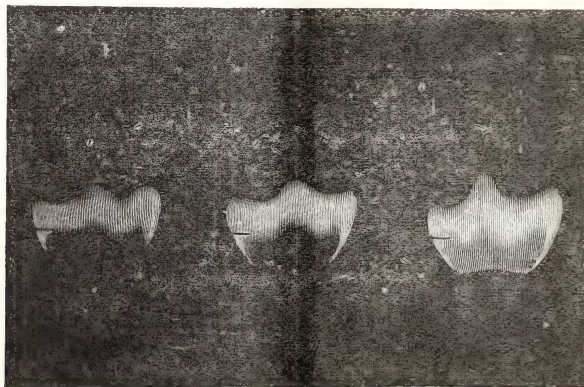


FIG. 6.

and consequently the quantity of light falling on the spot must vary beyond what it should do. It may be remarked that putting aside

this error the measurements are made from the slit and not from the source of light, which is a decided advantage. Messrs. Hurter and

Driffield have to a large extent got rid of this light and employ a flat flame, of large size, as the source of light, and use a small square aperture in front of the flat side. As the section of such a flame appears to be uniform, the inaccuracy of measurement introduced is done away with. In reference to this, it may be interesting to show that in an ordinary flame the light varies in intensity at different points. This can be done well by means of photography, reducing the exposure each time. Fig. 5 (p. 750) is an Argand burner flame, Fig. 6 (p. 750) a batwing, and Fig. 7 an ordinary candle.

It will be seen that in the candle flame we have an almost expected result. The Argand gas is more surprising. The batwing gas is perhaps the best, as it shows that in the wing used the intensity remains almost constant. I think these photographs will demonstrate to

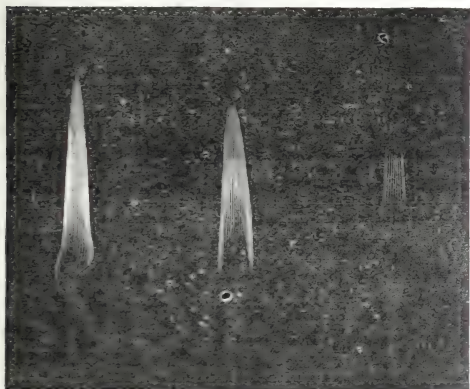


FIG. 7.

you that if the quantity of light to be admitted to a screen is to be determined by an aperture, the burner should be of the batwing type.

Before quitting the subject of photometers, I must introduce to your notice the radial photometer of Dibdin (Fig. 8). The diagram almost explains itself. The object of the photometer is to measure the illumination of a flame in all directions. It will be seen that the arm which carries the light to be tried remains always at the same distance from the screen. The screen itself is so arranged that its surface bisects the angles between the lines joining the two lights and itself—a most necessary thing, when Fig. 3 is taken into consideration.

We have now to turn to the method of judging the equality of light; that is, how the eye can best appreciate the light.

We are told very frequently that the eye can

appreciate about the $\frac{1}{100}$ th part in the intensity of light, or, say, 2 per cent. There is a story told of a celebrated witness who, when asked whether such and such a thing was the case, said:—"Yes and No." Now if I were asked the question as to whether the above limit was true, I could safely answer in the same terms. First of all let me show you an experiment, which will prove that this limit is both understated and also overstated. I have on this screen a variety of greys between black and white. We can now see them all, and the difference between them. If I turn down the light, a great many of these appear the same tint. If I turn on to them a very strong electric light, those not nearly white, when looked from where I am, appear white, and it is only when there is considerable black in the shade of tint that they appear grey.

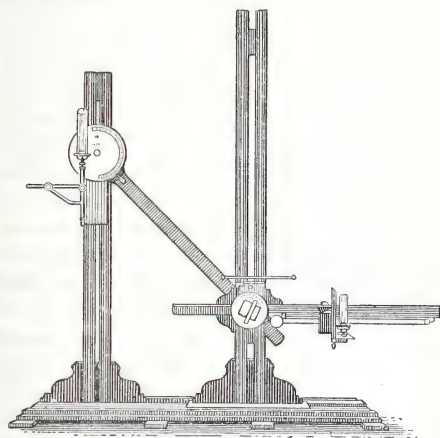


FIG. 8.

As a matter of fact, there is an intensity of light, in which much smaller differences than the $\frac{1}{100}$ th can be perceived. I believe, for my own part, that, when the light is suitable, a difference of nearly $\frac{1}{200}$ is recognisable. But it is not necessary that the eye should be so sensitive as the above, so long as proper precautions are taken in balancing the light. If we balance from "too light" and then from "too dark," the mean will be fairly exact, and probably not be far off the truth by a good deal less than 1 per cent. But there is another plan, which is better still, and that is by rapid oscillations in intensity on each side of the true point. This is difficult with many photometers, but not with all. When this plan is adopted, supposing we are using the shadow method, the two shadows appear to *wink*, and, when exactly balanced, this winking stops. It is curious how, without this artifice, readings,

which can be proved to be palpably wrong, are made. For instance, when one shadow is intensely darker than another, the eye of the observer will fail to see it, when the alteration is made slowly. If the eye, however, has a rest, by looking away at some black object, the inequality of the shadows will at once be seen. This cannot happen when the method of rapid oscillation is adopted.

What the cause of this may be is not absolutely proved. When the eyes look at two objects (spots or shadows) the images of the two are projected on different parts of the eye, these portions get fatigued, and the longer they are looked at the greater the fatigue. The brightness of the two gets lowered and they gradually approach one another. When the system of oscillation is adopted, though both images are lowered in tone, yet there is a constant brightening and dimming in both, not sufficient rapid to make each of them practically uniform in a tone midway between the two, but scintillation is produced. We can see how the eyes can be fatigued by a very simple experiment. I will throw a bright patch from the electric light upon the screen, which is also partially illuminated by gas-light. If the audience look at it for a few seconds, and keep their eyes fixed on the screen when I cut off the electric light, they will see a dark spot where the bright patch was, and it will appear to travel about as the eye wanders over the screen. This shows that the part of the retina on which the white patch was received is fatigued, and is less sensitive to the feeble gas-light illumination with which the screen is illuminated.

Some very instructive measures of the sensitiveness of the eye to different shades of light can be made by a sector arrangement. Black

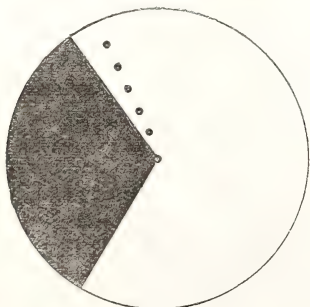


FIG. 9.

dots of any size required (in the case in point they have one-eighth of an inch in diameter) can be placed on a white disc, as shown.

This disc is cut radially from the centre, and a black disc is marked out in the figure. The proportion of black and white can be altered at pleasure, and a further slight alteration in the grey produced is made by the dots; the smallest alteration, of course, being when the dot subtends the smallest angle. By this plan the sensitiveness of the eye to any small change in light can at once be found. The sector may be varied between all white to nearly all black. Similarly white dots may be placed on a black disc, a white disc overlapping, and unique measures made. It must be remembered that in all cases the black itself reflects a certain amount (in this case about 4 per cent.) of white light.

Miscellaneous.

AN EARLY SOCIETY OF ARTS.

In the account given in the Dictionary of National Biography of Robert Morris, a writer on architecture who lived in the last century, reference is made to a "Society for the Improvement of Knowledge in Arts and Sciences," which was founded by Morris about 1730. It is interesting to know that twenty-four years before the establishment (in 1754) of the Society of Arts, a society having, apparently, similar aims, and certainly a very similar title was proposed. Nothing more, however seems to be known about the proposal than is contained in a reference in a volume of lectures on architecture published by Morris in 1734. The lectures, it appears, were delivered before the society, the first in 1730, and the last in 1734-5. It seems probable that it was merely a small private society consisting of Morris and his friends. He was, he states, the President. No mention of the society appears among the Proceedings of Societies in the British Museum. The information contained in this note was obligingly furnished by Miss Bertha Porter, the writer of the biographical notice.

DEVELOPMENT OF THE RAILROAD IRON INDUSTRY IN CHINA.

The United States Consul at Hankow says that one of the most wonderful establishments in China is the arsenal, and vast rolling mills now approaching completion in Hanyan, a city opposite Hankow on the Han side. The plant covers about seventy acres, with a railroad a mile and a half in length from the Yangtze River to the works, and thence to the Han River, with an incline from the top of the Yangtze bank to the water, where powerful machinery is fixed

to draw the cars up a steep incline of about three hundred feet to the level. The buildings are located in a valley liable to overflow, and their foundations have been raised fifteen feet, consisting of a bed of concrete made of brick, stone, and Portland cement, covered with a layer of earth, the whole of which was carried in baskets by coolies—the labour of thousands of men. The work was commenced in 1891. The buildings are of brick, with stone foundations, handsomely designed and most elaborately and solidly constructed. The brick used in the construction of the works is made on the ground by machinery, the clay being moistened and ground, then passed through a press, forming a continuous slab, which is automatically cut in pieces a yard in length. The piece is forced against a frame interlaced with wires that severs it into ten perfect hard-pressed bricks, which are then conveyed by hand to the furnaces and burned. All the firebrick for lining the furnaces, casing, &c., was also made in these yards. There are four immense hot-air blast furnaces, two large steam hammers, and innumerable rollers, with all of their appendages for manufacturing railroad iron, which is the main object for the erection of the plant. Large quantities of Chinese iron are now in the yard, with some English iron for blending purposes, and coke is being imported from Wales to be used temporarily in the construction of rails, as soon as the machinery can be put in operation, as a test of what the foundry can do. The sheds, covered with corrugated iron, cover an area of twenty acres. The smelters are of the most improved patterns, and a large furnace is to be devoted to the manufacture of Bessemer steel. Consul Child says that when finished this establishment will be one of the most complete rolling mills in the world, as expense appears to have been a secondary consideration in its erection. It is estimated by experts in such matters to have cost not far less than £700,000, and it will cost at least £200,000 more to complete it. Once in operation it is the intention of the viceroy to manufacture ordnance, rails, machinery, small arms, &c. The mines from which the metal for the manufacture of rails is to be obtained are near Wang-Shih-King, about 76 miles below Hankow, 16 miles inland at Tayeh, connecting with the river by a well-constructed railroad and dock at a landing three miles below Wang-Shih-King. The ore is reported to be of good quality and inexhaustible. Coal, both hard and soft, is mined in the neighbourhood, no effort being made to drain the mines of water, and once flooded they are abandoned, and new ones opened. This coal has been pronounced by experts as not suitable for smelting, containing too much sulphur, but it is thought that a good quality can be obtained from mines now undeveloped. Mines of iron and coal abound in the district, and can be made to furnish all the material needed, if mined systematically, and owing to the cheap labour obtainable, they can be worked economically. Consul Child, in conclusion, observes that if the plant is

successfully operated, it will prove a revelation to the natives of that portion of China in which Hankow is situated, and do much to disabuse their minds of the idea of their own infallibility, and convince them of the benefits to be derived from the genius and skill of the foreigner. Taken all in all, it is the most progressive movement so far made in China for the purpose of manufacturing arms, steel rails, and machinery, as the plant is a perfect one, and of magnitude sufficient to require several hours to inspect it.

AGRICULTURAL PRODUCTS OF NICARAGUA.

The principal agricultural wealth of Nicaragua lies in its coffee plantations, and although this industry is still in its infancy, every year witnesses its augmentation, and the Bureau of the South American Republics states that the time is near at hand when Nicaraguan coffee will take the prominent position to which it is certainly entitled. There are millions of acres in the country that are especially adapted to its cultivation. Coffee grows well almost everywhere in Nicaragua, but best in the mountainous districts. The production at a height of from 200 to 2,000 feet above the level of the sea is generally at the rate of $\frac{1}{2}$ lb., and in some cases 1 lb. per tree. At an elevation of 2,000 or 3,000 feet, the production fluctuates between 1, 2, 3, 4, and even 5 lbs. per tree, according to the quality of the ground. At a higher altitude the production diminishes gradually until it ceases entirely on account of the cold temperature. There are, in Nicaragua, certain coffee regions offering the best possible advantages for the cultivation of this plant. They are to be found in the departments of Managua, Carazo, Matagalpa, Chontales, Jinotega, and on the slopes of the hills and volcanoes of the other departments. For some years past, in consequence of the high price of coffee, a great impulse has been given to its production. According to the public records, 24,598 manzanas of public land were taken up in 1890, of which 16,740 manzanas were intended for the cultivation of coffee. Of these, 8,491 manzanas are in the department of Matagalpa, and 4,101 in that of Managua. In the department of Matagalpa alone, there are at the present time about 2,000,000 young trees under cultivation, which will begin to yield in about a year's time. The construction of the Nicaragua Canal, and of railroads that are projected to the Atlantic coast will, it is expected, give an immense impetus to coffee-growing. The production of india-rubber is an important industry in Nicaragua, but it is annually decreasing from the reckless slaughter of the trees. India-rubber, called in South America *caucho*, and in Central America *hule*, is obtained in South America from the *siphonia elastica*, a tree growing to 50 or 60 feet in height. The collectors of rubber, called *huleros*, employ

several methods to obtain it. In some cases the trees are felled, and channels cut round the trunk, from which the sap or milk flows; in others the tree is left standing, and two or three vertical channels, according to the size of the tree, are cut through the bark from top to base; then numerous oblique channels are cut connecting with the vertical ones. To do this work, the *huleros* improvise ladders from the vines and creepers, which everywhere abound in the tropical forests. In all the lower regions of Nicaragua, particularly in those extending towards the Caribbean coast, there are large tracts of land suitable for growing rubber trees, and it is said that their cultivation would prove very profitable to anyone who could afford to wait for a return from capital invested until the trees reach maturity, which is from seven to ten years. Bananas are largely grown, and when the bars at the mouths of the rivers are improved, and when the interoceanic canal and railroads afford means of transportation, this fruit will become a still more prominent feature in the exports from Nicaragua, and the large profits yielded to the producers will stimulate agricultural operations on thousands of acres of fertile land now practically uncultivated. There is a variety of the banana family, the plantain, whose production in Nicaragua need only be limited by the demand for it, which must become immense when its merits are appreciated. In Nicaragua this fruit is boiled, stewed, baked, roasted in the ashes, fried, dried and ground into flour, cooked in the skin or out of it, green or ripe, and produces much more nutriment per acre than is yielded by wheat, maize, or potatoes. Cacao is grown in Nicaragua, and is sold with advantage in the markets of the world. The sugarcane grows with extraordinary luxuriance. The canes are soft, and contain no more woody substance or less saccharine matter than those produced in the East or West Indies, where their duration is wonderful. A great deal of the sugar manufactured in Nicaragua is of a coarse brown quality, the juice being merely boiled until it crystallizes, without being cleared of the molasses. In this crude state it is poured into moulds forming small cakes, which are sold to the poorer classes. A very large quantity of the sugarcane is used in the manufacture of a species of rum called *aquardiente*. The bulk of the sugar produced in the Republic is manufactured in the district of Jinotepe, in the Department of Granada, where, although very primitive and imperfect methods are employed, it is stated that in the year 1890 the production amounted to about 2,500,000 pounds. The total production for 1890 exceeded 3,500,000 pounds. Cotton is indigenous in Nicaragua, and the finest quality can be produced in vast quantities. Instead of being an annual plant, as in the United States, the cotton plant is perennial in Nicaragua, and growing much larger, yields double the quantity that it does in the most favoured locality in the United States. Maize, rice, and tobacco are abundantly grown. Indigo and

cochineal were formerly produced in large quantities, but as they have been superseded by the introduction of mineral dyes, the cultivation of these articles has almost entirely ceased. The *yuca*, the yam (*ñame*), and the sweet potato are the principal farinaceous root that are extensively cultivated. The *yuca* is not only useful for food, but valuable from an industrial point of view, as the starch it yields could readily be made an extensive article of commerce. The breadfruit grows to perfection in Nicaragua. The tree consists of a massive trunk with dark green leaves, and it begins to bear about three years after planting. It yields two crops in the year, one lasting through March and April, and the other from August to October. Each fruit weighs from six to ten pounds, and is said to have a delicious taste when fried or boiled. The cocoanut tree is abundant, and on the Caribbean coast it is an important article of commerce, although no efforts have been made to utilise the fibre of the husk. *Frijoles*, the brown beans that form such a prominent article of diet throughout Spanish America, are produced abundantly in all parts of the Republic, while all other tropical fruits such as oranges, lemons, limes, citrons, pine-apples, guavas, mangoes, &c., grow in great profusion. The vegetables of the temperate zone grow luxuriously in the more elevated districts.

NORWEGIAN TIMBER TRADE.

Writing on the subject of the timber trade of Norway, the French Consul-General at Christiania in a recent report states that the export of timber from Norway which, in 1891, amounted to 1,931,561 cubic metres, was further reduced in 1893, when, according to official statistics, it only reached 1,686,505 cubic metres. It was therefore lower by 207,220 cubic metres than in the preceding year. As regards the different kinds of timber the exports were distributed as follows:—

	Cubic Metres.
Planed	504,140
Sawn.....	454,487
Beams	83,114
Cleft logs	484,208
Firewood	74,655
Staves	85,901
Total.....	1,686,505

The following shows how the exports were distributed as regards the countries of destination:—

	Cubic Metres.
United Kingdom.....	1,093,975
France	126,229
Belgium	116,492
The Netherlands	93,818
Germany	71,419
Denmark	31,302
Sweden	38,542

	Cubic Metres.
Spain	21,404
Australia	34,526
Africa	39,188
Brazil	6,046
Iceland	4,528
Asia	2,711
Egypt	2,283
Argentina	1,758
Algeria	821
Faroe Islands	761
Portugal	540
Gibraltar and Malta ..	164
Total.....	1,686,505

From the above it appears that England is the most important market for Norwegian timber, and although there is a diminution this year compared with 1892, when the imports reached the figure of 1,232,123 cubic metres, this country absorbs more than half of the total exports.

Probably owing to the new Customs regime, the consignments destined for France have shown a large diminution. Thus in 1891 the total imports of Norwegian timber into France amounted to 240,363 cubic metres, whilst in 1892 they only reached 136,096 cubic metres, and in 1893 126,229 cubic metres.

For several years there has been a marked tendency in the market towards lower prices. A reaction suddenly set in last autumn. This change is attributed to the small reserves then held in both the exporting and importing countries. Although the general exports for the year 1893 were less than in 1892, the total yield does not seem, however, to have been less, for the prices for planed and sawn timber were much higher than in 1892, especially during the last quarter, when buyers paid from 10s. to 15s. more per standard.

This enhancement, which would equally arise from reduced stocks of planed timber, being felt in England, has also been occasioned by the relatively unimportant exports from Sweden, a country which is a powerful competitor with Norway.—*Board of Trade Journal.*

ONION CULTIVATION IN EGYPT.

The onion crop of the valley of the Nile is of great importance, and brings an increasing amount of money each year to Egypt, as onions are shipped in immense quantities to England, France, and other European countries, and to the United States, where they find a ready sale at good prices. The quality is stated to be so excellent, that efforts are being made in other countries to grow onions from Egyptian seed. The United States Agent and Consul-General at Cairo says that in all departments of Egyptian agriculture, watering is accomplished by means of irrigating from the Nile, either directly or from

canals. The more popular Egyptian onion, known as *Baali*, is grown in yellow soil, sparingly watered while the bulbs are maturing, that they may stand a lengthy sea voyage with little risk of sprouting. There are two stages of cultivation, the first covering the season of the sprouts for transplanting. Towards the end of August or the beginning of September, the land intended for the onion crop is irrigated from the Nile. After letting the water run off, it is left to dry until the first ploughing, when the ploughshares penetrate not deeper than four fingers' breadth. All clods of earth are broken up and pulverised, and the land is divided into plots about ten feet square, and stirred lightly with a mattock—the favourite implement of an Egyptian farmer, which is double-headed, one side being broad, like an adze, and the other like a pickaxe. The seed is then scattered freely and evenly, at the rate of about two bushels to the acre. After sowing, a plank is passed lightly over the soil to cover the seed and bring the plots to the same level. The plots are then irrigated, the islets along the Nile being irrigated four times and the raised lands six times. The first irrigation takes place immediately after sowing, and the water is completely absorbed; a second, and very light watering, is given, as soon as the plants appear above ground, and the borders of the plots are sprinkled. If the seed is planted in raised land, manure is applied, but if sown in low ground there is no need of manure; the onions ripen in the first fortnight in October. The second stage covers the period from the transplanted sprouts to the mature onions. Land intended for *Baali* onions is soil of good quality, with no weeds or grass, or yellow land of the same quality, and damp enough to allow the crop to grow and ripen. It is irrigated in September, and it is ploughed three times, the ploughshare penetrating to a depth of about eight inches. After the third, and last, ploughing, the onions are set out in furrows, at a distance of four inches apart. The furrows resemble wheat furrows, and the earth covers the onions in the second furrow. In ploughing the last time, the cultivator plants the bulbs in the furrow; the plough, returning in the second furrow, covers them. The stalks, or tops of the seed onions, emerge from the soil to a height of four fingers' breadth or more. Every 20 days the weeds are pulled out, in order that the onions may be clear and allowed to develop. In the month of April the tops die, and the onions are pulled, and when perfectly dry are packed in coarse sacks and sent to market. *Baali* onions in their second stage are never watered directly. *Miskaoui* onions absorb so much moisture from the frequently irrigated ground in which they grow that they are seldom exported. They are sown in the same way as the *Baali*, that is, the sprouts are used as seed, and any kind of soil can be used. The land is irrigated at the beginning of September, and, after the water has run off, it is left to dry until it can be ploughed. It is ploughed twice, and divided into plots 10 feet square, each

furrow being a little over two inches deep and nearly five inches wide. The plants are laid in the furrows, at distances of four inches, and the water is immediately let in. The second irrigation takes place in 12 days, and the third in 24 days; after this, the soil is watered every eight days; the ground is then left 10 days without watering, and the onions ripen and are unearthed; they are known to be mature when the tops become dry. The cultivator plants the sprouts in the furrows, head downwards, burying them to the depth of four fingers' breadth.

SWEETMEAT INDUSTRY IN TURKEY.

The *Revue d'Orient* says that of all the various descriptions of confectionery prepared in Turkey, that known by the name of *locoum* enjoys the highest reputation. This sweetmeat is manufactured at Constantinople, Smyrna, and Syra, and is exported in very large quantities, principally to Marseilles. There are different kinds of locoum, according as to whether for flavouring purposes essence of roses, pistachio, or almonds enter into its composition. In Turkish, locoum is called *rahat locoum*. It might be supposed, in seeing the warm and transparent colour of this sweetmeat that a variety of elements enter into its composition, and that it is a difficult thing to make, but, as a matter of fact, only two ingredients are used—sugar and starch, and its preparation is very simple. As regards its manipulation, great care and attention must be devoted to it, and in this lies the whole secret of its manufacture, which has never yet been successfully accomplished in Europe, although very frequently attempted. The first operation is to melt some starch in cold water; this starch is then placed in a large pan with a certain quantity of sugar, and the pan is placed on a fire for about two hours, two men taking it in turn to stir the mixture. The sugar must be stirred without intermission, and always in the same way, otherwise the paste will not become uniform; any mistake in this manipulation resulting in the crystallisation of the sugar. When the paste is well formed, it is poured out into little wooden moulds, these moulds being first of all sprinkled with finely powdered sugar, to prevent the sweetmeat adhering to them. The contents of the moulds are then poured out on to marble slabs, and, by the aid of a peculiarly shaped knife, the locoum is cut into strips about three centimetres wide, and these strips are again cut into small cubical pieces. It has been stated above that pistachio and almonds are used in the preparation of locoum, and to these must be added mastic, but these articles are only introduced when the cooking of the mass is completed, they are then in certain proportions added to the paste, which is well-stirred. In the case of the mastic, this, reduced to a very fine powder, is thrown into the pan at the very last moment. It may here be observed that mastic is

very largely used, and in many different ways, in the East. There it is used by women, who chew it, with the object of imparting fragrance to the breath and a good colour to the teeth. The men mix it with alcohol during distillation, and a cheap liqueur is obtained, which is largely consumed. The best mastic comes from Chio. Another Turkish sweetmeat much in request is *halva*, which is a kind of nougat. There are two kinds of halva, one manufactured and sold by the Albanians, which is composed of sugar, worked up and mixed with nuts; the other is made of sugar, simply boiled and concentrated, and then poured out on to marble slabs with pistachio nuts and allowed to crystallise. Turkish halva, or *tahin halvassi*, requires a much longer and more detailed preparation than locoum. Halva is a product of Constantinople, and from there it is exported in large quantities into the interior, where it is held in great esteem. There are certain periods of the year when halva becomes almost the sustenance of the Christian and Armenian population. The method of making halva is as follows:—A large pan with a diameter of about five feet is placed in a cavity of a wall and a fire lighted under it. Above this pan, held by a chain, is suspended a large beater about six feet long. Into the pan a quantity of sugar is placed to which water is added, when the fire is lighted. When the mass commences to melt, one of the workmen engaged, takes the beater and regularly stirs the mass, this operation being continued by other workmen, who take turns at it for a period of three hours. Very great care and attention is necessary to this operation, as one moment's stoppage or an irregularity, or change of the movement of the beater would result in the probable spoiling of the whole mass. When the sugar is sufficiently concentrated and worked up, a certain quantity of sesame oil is added, and when the mixture is ready it is poured out of the pan into a copper receptacle. Sesame oil is again added, and the preparation is allowed to remain until it is sufficiently cool for a workman to work it up with his hands. This last operation requires about half an hour to perform, after which the paste is left to get cold. There is another kind of halva known as *keten halva*, the preparation of which is very complicated and requires about six hours. When the sugar is melted, and has obtained a certain degree of concentration, it is placed in a *tepsi*, or large round dish. All round this dish is placed melted butter containing a fine description of flour, and the concentrated sugar is turned round and round in the dish, and in such a manner as to absorb little by little a certain quantity of the butter and the flour. This operation is continued until the mixture of butter and flour is completely absorbed, and until it is finished a gentle heat is maintained under the dish to prevent the mass getting cold. The paste is then subjected to a variety of operations necessary to produce it in the form that it is placed upon the market, namely, in the form of silver threads. Besides the Turks, the Persians excel in the preparation of halva.

THE CULTIVATION OF COTTON IN COREA.

The Commissioner of Corean Customs at Fusan says that the total area under cotton cultivation throughout Corea is roughly computed to be 872,000 acres, and the aggregate quantity of seed cotton, that is to say, uncleaned cotton, produced per annum is set down as 1,200,000,000 lbs. The bulk of this comes from the provinces of Whanghai, Cholla, and Kyongsang, where the climate and soil are most suitable to the growth of the plant. The yearly consumption of "cleaned" or raw cotton is roughly estimated at 300,000,000 lbs., and considering that the majority of Coreans use cotton almost exclusively, this estimate may be regarded as rather under than over stated. Taking the population at 12,000,000, it would give 25 lbs. of cotton per head. The greater portion of the cotton is made into piece goods for garments and padding for winter clothing. Much of the cotton is also used for the padded socks worn both in summer and winter by the nobility and well-to-do classes—a custom peculiar to Corea. The Corean fibre is reported to be superior in durability and in warmth-giving qualities to that produced in Japan. A piece of the cloth as manufactured in Kyongsang usually measures 60 feet by 14 inches wide, weighs from 3 to 4 lbs., and varies in price from 2s. 1½d. to 2s. 8d. The quantity of raw or clean cotton raised is said to average 85 lbs. per acre, and of seed cotton 345 lbs. per acre. Mr. Hunt says that there is reason to expect that an increase will take place in the production of cotton. Ground suitable for its growth is practically plentiful, and it needs but a steady market at remunerative prices to stimulate an extended cultivation. At present only a small per-centage of the area available is utilised. The plant, properly speaking, is not an annual, but it is found to be more profitable to uproot it after the crop is gathered and sow new seed each year. The dead stalk is used for fuel, and its ashes finally for manure. The method of cultivation is as follows:—The ground is usually ploughed up during the early winter, and allowed to remain in this condition until the frost is well out of it, when it is broken up with a hoe, and manure, mixed with wood ashes, spread over it. The fields are now ready for the reception of the seed, which is generally sown about April to May. The seed, of which there is but one kind, is not placed in drills, as is done in Japan, but is sown broadcast, and then trodden in and covered up with the feet, sesamum seed being very often sown in the same field with it. The young shoot shows above ground about the tenth day, and at maturity attains a height of from 2 feet to 2½ feet. The plant blossoms in August, and on an average bears 40 pods, each containing four cells, as a rule within a double capsule. The gathering of the crop, which begins about October, continues until frost sets in, some time in November. The plant flourishes best in a sandy loam soil, on the low hill sides, or in the valleys, in weather slightly moist from the sowing of

the seed until it appears above ground and blossoms. After this dry weather is essential, rain checking the proper maturing of the fibre. No attention is paid or skill displayed in the cultivation once the seed is in the ground; everything is then left to nature. No further manure is added, nor are they ever thinned out or given water in times of drought. The crops are gathered by women principally, who also are largely employed afterwards in separating the seed. The instrument used by the natives in this process is the primitive roller gin, but the Japanese in Fusan have recently introduced machines of the modern saw gin type, and obtain 35 lbs. of clean cotton from 140 lbs. of seed cotton a day. A native woman can, with the roller gin, turn out per day about 3 lbs. of clean cotton from 12 lbs. of seed cotton, the proportion in weight generally estimated being 1 to 4. The spinning wheel in common use all over Corea, unlike the western "jenny," makes but one thread at a time. Before spinning, the cotton is prepared in a similar manner to that in China, with the elastic bow, the string of which being struck after it is passed under a quantity of cotton laid on a table tosses the cotton into the air by its rebound, and so separates the staple without injury.

THE RUSSIAN WOOL INDUSTRY.

The *Moniteur Officiel du Ministère des Finances de la Russie* has recently published some particulars respecting sheep-breeding and the wool industry in Russia. According to this report, it was in the Government of Taurida—that is to say, in the Crimea—that a French engineer in the service of the Russian Government introduced a breed of merinos into the country at the end of the last century. At the present time the principal breeding district is the region of the Don, and for some years past large sheep, for killing, have been exported to France, the greater part being received at the ports of Marseilles and Havre. In 1890, the number of Russian sheep exported on the European frontiers amounted to 108,000; in 1891, to 295,000; and in 1892 to 226,000. The largest wool market in Russia is Rostoff, the great port of the Sea of Azov, which received, in 1892, 25,358 tons of wool, of which 18,815 tons were merino, and the remainder the product of Russian breeds. The greater part of this wool—about two-thirds, in fact—is bought by the spinneries of Moscow and St. Petersburg, the remainder being taken by France, Italy, Germany, and the United States; but the spinning, weaving, and other factories for the production of woollen tissues, being constantly on the increase in Russia, the exports of the raw material must naturally diminish. At the present time, Russia is beginning to import foreign wool, and it is anticipated that the sheep will soon cease to exist, for eating purposes, in the Governments of the South, Bessarabia, Taurida, Cherson, Don, &c., and that the breeding grounds

will be pushed forward towards the east: in Turkestan, Bokhara, &c., where the population is sparse, and where large and uncultivated plains are eminently adapted to the purposes of sheep breeding. Merino wool is sent in bales from the places of production, without passing through any process of washing or cleansing; it is only the wool produced by the Russian breeds that is subjected to these operations when exported, with the exception of that shipped to the United States, where the import duties on washed wool are exceedingly high. Sheep shearing is carried on at the commencement of May, and a second shearing is done at the beginning of September. As a rule, the merino sheep yields about 10 lbs. of wool, and the Russian sheep about 8 lbs. In 1892 the exports of wool amounted to about 24,000 tons, and of this quantity the United Kingdom took about 60 per cent., the remainder being distributed between France, Germany, and the United States. As regards the imports of wool into Russia, these have not attained any great importance; in 1892, 4,600 tons of raw wool were imported. Woollen tissues come, for the most part, from Germany and the United Kingdom, the proportion being about 50 per cent. of the total imports, in the former case, and 18 per cent. in the latter.

TURKISH MOSAIC WORK.

Turkish mosaic and inlaying work are the richest examples of the Oriental decorative art. There are very few mosques which do not possess valuable ornamental work of this kind, shutters and panels and many other articles being usually decorated with mosaic and inlaid work. The Arabic design is frequently carved out and cut to receive the incrustations of mother-of-pearl, ivory, bone, and also of metal. The *Revue d'Orient* says that, in addition to the many beautiful specimens of mosaic on a large scale to be found in the various mosques, similar mosaic work is employed sometimes on a miniature scale for pictures on the lids of snuff-boxes and articles of that kind, or tablets in chimney-pieces, which are very curious works of art. At the bazaar in Stamboul many articles decorated with mosaic work, such as boxes, razor-cases, &c., are to be seen, which have been decorated with remarkable finish and delicacy. The mosaics themselves are frequently only a millimetre and a half long; they are placed together so perfectly and with such care that it is impossible to discover where they join, and they are composed of various materials which are glued on a flat surface. Modern operators use ordinary glue, but the ancients employed another material, of which the secret is lost. At the Church of St. Marie, belonging to the Commercial School of Halki, there are two wonderful tables of an octagonal shape, which are ornamented with religious pictures on wood, and decorated with mosaic work. This particular work dates back to the 14th century. In

mosaic work the materials most frequently used are mother-of-pearl, ivory, bone, tortoiseshell, and ebony. As regards the execution of the work, this is very simple. The operator, seated on a cushion, has in front of him a kind of small table, which serves for a bench. On this table are nailed two wooden cogs, and it is against these that the workman places the pieces of mother-of-pearl or tortoiseshell that he cuts into the necessary shape by means of a small saw, and trims with a file. In the first place, a piece of wood is cut up in the form of a polygon; the centre once indicated, lines traced in pencil radiate from it to the extremity of the polygon, and these lines serve to guide the placing in position of the pieces of marqueterie, cut in diamond or triangle shapes. Each piece has then its axis placed on the line. This is sufficient for the outline, but the artist executes the most varied and original designs. He changes the form of the diamond-shaped pieces, and places them so that the various colours should be properly blended, and it is very rare to see two designs exactly alike. It is said that when the work is commenced it frequently happens that the operator himself does not know what design he will eventually produce, but this he works out during the operation. The *sâdepli iskemle*, or small inlaid table, is the article of furniture which is turned out in the greatest quantities at Constantinople, and which is most in favour in Europe. These tables, when possessing inscriptions, are highly prized, and fetch as much as from three to ten Turkish pounds, according to size.

General Notes.

ACCIDENTS AND MUTUAL INSURANCE.—An International Congress on accidents happening during work, and mutual insurance, is announced to open in Milan on 1st of October. The first Congress was held in Paris in 1889, followed by another at Berne two years later; and the organising Committee of the Milan Congress, of which the Syndic, Signor G. Vigoni, is President, considers that, adopting the Italian motto "*Provando e Riprovando*," it will be able to put forth some new and original ideas on the subject.

PROPOSED EXHIBITION AT BORDEAUX.—In reply to a letter from the secretary of the Chamber of Shipping, the Secretary of State for Foreign Affairs has written stating that, having consulted various public departments concerned in such undertakings, he learns that the Exhibition to be held at Bordeaux next year is promoted, not by the French Government, but by a local society. In these circumstances her Majesty's Government will take steps to give publicity to the programme and other documents setting forth the scope and object of the Exhibition, but they are not prepared, as suggested by the Chamber of Shipping, to appoint either a committee or commissioner to look after British interests in connection with the Exhibition.

Journal of the Society of Arts.

No. 2,176. VOL. XLII.

FRIDAY, AUGUST 3, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Proceedings of the Society.

CANTOR LECTURES.

PHOTOMETRY.

By CAPTAIN W. DE W. ABNEY, C.B., F.R.S.

LECTURE III.—*Delivered April 16, 1894.*

The sensitiveness of the eye to changes in intensity, I have shown you, varies according to the intensity of light from which the variation takes place. As my time is short, I must omit some other theoretical considerations which it was my intention to show you. I will first of all commence by showing how it can be ascertained whether a light is up to the standard temperature, such standard temperature being required for visual and photographic comparisons.

It is well known that by mixing two properly chosen spectrum colours white light can be formed, and when I say white light, I mean the colour of the light under trial. Now, for lecture purposes, it is useless for me to try and use the light of a candle to form a spectrum. It would be invisible to you all; but I can use the electric light just as well for the object I have in view, viz., the demonstration of the principles involved. Now the whiter the light, the more blue and violet there is in its spectrum. There is, therefore, a large quantity of blue and violet in the electric light. I will form a spectrum, and place a slit in the orange and another slit in the blue, so that I can have a slice of each coloured light. By means of a lens I can cause these two slices of spectrum colours to expand and overlap and form an image of the face of one of the prisms used, and I can then cause a beam of the original light to illuminate a white surface alongside of it. The two slits can now be opened till they

form by their mixture exactly the same colour as the original beam. Let us see if we use another source of light whether we shall get exactly the same result, keeping the slits as they are. I tone down the electric light by a very pale yellow glass: the light imitates very closely gas-light. If we place it in front of the slit of the spectroscope, so that the spectrum is the spectrum of the yellower light, and the incident beam is the yellow light, you will see at once that the mixture of the two colours no longer gives the same colour as the yellow light. Making the light the same as the amylacetate lamp light, you will see again that the balance is upset, the two patches of light on the two white surfaces are no longer the same.

Here, then, we have an indication of the method to pursue in ascertaining if lights are of the same quality. By having two adjustable slits in the spectrum, which will with a standard light exactly match the colour of such a standard, we can at once see if any other light is of the same value; if it is not, the two illuminated surfaces will be of a different hue. Another plan is to use proper coloured glasses in front of a lens, and allow light to pass through them in such proportions that they cast an image of a beam of exactly the same colour as that of the standard light itself. When another light is used, equality of colour no longer exists.

There is one method of altering the intensity of a light, if it be a glow-lamp which may interest some. In the first lecture I showed how the visible rays increase in intensity in a parabolic curve. This was further investigated by General Festing and myself. If each ray goes up parabolically, it is probable that the sum of them does the same. In a paper read at the Royal Society on December 8, 1887, we showed that our surmise was correct, and that if a constant was deducted from the current multiplied by the volts the result was the square root of the light multiplied by a constant— $(w - m = n \sqrt{y})$, which is a parabolic. By altering the resistance in the lamp, and reading an amperemeter, and a voltmeter, the result is obtained, though it is sufficient if the amperes alone be read, for then $c^2 - s = t \sqrt{y}$, very nearly when c is current and y the light, s and t being constants.

As to the use of the sectors, it has been brought to my notice that Mr. Ferry has called in question the accuracy of the sectors when comparing lights of different colours with one another, such as lime-light

and a glow-lamp. He states that for light of the same colour, and for monochromatic light, no error can be found in its use. I may refer, however, in opposition to this, to some experiments which were carried out by General Festing and myself, in which the luminosity of the spectrum was measured without the intervention of the sectors, comparison having been made with a glow-lamp. It was found, as published, that the two methods gave identical results. There are many other experiments which show that no error in the results obtained with the sector have been found by us. That this is the case, we may take to be the fact by direct and by indirect measures.

There is, in my opinion, no method so good in photometry as that of using properly moving rotating sectors, whose open apertures can be altered at will. It allows both lights to remain stationary, as, also, the screen. This method of diminishing the intensity of the light was, I believe, first introduced by Fox Talbot more than fifty years ago, though he had not the advantage of using moveable apertures. This principle of altering the aperture during rotation I first saw exhibited by Mr. Kempe, Q.C., at a *soirée* of the Royal Society. It was applied to a colour top. Without entering into the history of the matter, however, let me show you the exactitude with which such sectors can be employed.

In doing this, I wish to introduce to your notice a photometric method which I brought out, and is, I believe, very fairly successful. I am not saying it is the very best for comparing ordinary lights, but it fills a gap for measuring light transmitted through bodies, which is very convenient. The principle of the screen, you will at once see, is different from almost any other. It consists of a square aperture cut in a thin disc, and over this is stretched a white piece of paper of such a nature that the light from an illuminant is only scattered, and no direct image can be

FIG. 1.



Back View.

seen under any circumstances. On the other side is cut a mark in black paper or black

retint, which is exactly double the size of the cut-out square, and this is filled up by the

Front View.



FIG. 2.

white paper stretched over the aperture, so that we have a rectangle of paper half of which is translucent and the other half opaque. If now we place a light behind the aperture, the half is illuminated by transmitted light, and if a light is placed on the other side, the whole rectangle is illuminated. By placing a rod in the path of this last beam, we may cast a shadow which prevents the last illuminating the half through which the transmitted beam comes, and then we have half the paper rectangle illuminated by transmitted light, and the other half by incident light. If the paper be of good quality, the light will appear of the same colour. By placing the rotating sectors in the path of the front beam, and altering the apertures, we may cause the two to appear of equal brightness.

Now suppose I want to examine the amount of light transmitted through this piece of ground glass, I can readily do it. If I place it near the candle, and use an ordinary Bunsen or Rumford photometer, I shall find that it varies according as I place it close to the source of light, or half way, or close to the screen. It is quite evident that the closer I place it to the screen, the truer will be the measure of the total amount of light transmitted. With this photometer I can get the ground glass close to the screen, and we then get a measure of the transmission of light through it. An objection has been made that light has been reflected back from the surface of the white paper to the glass, and back from that surface again. This may be true to a very limited extent. If I take a piece of ordinary glass, and hold it close to the lamp, I can balance the two lights, bringing it closer and closer, till it in fact almost touches the aperture, you will see that the balance is undisturbed. A variety of experiments has shown that any error caused by this is negligible. We can take a piece of a photographic negative, and test it in the same way, and balance it, and move it at different distances towards

the screen; we find that if we strike a balance when it is near the light it becomes apparently darker as it approaches the light, then gets lighter and lighter, till it appears lightest of all as it approaches the screen. Another point is this, that it need not be used in a totally dark room, where provision is made that any light there is must pass through the body under measurement; a small amount of diffused light is of no very great moment anywhere, since it illuminates the front of the rectangle, and has no effect on the measures of the light transmitted. We can also use it for coloured objects, such as coloured glass. For ordinary purposes it suffices if the glass be placed against the aperture, or in the path of the beam somewhere, so long as the aperture is only illuminated by the light transmitted through the glass. This makes one half coloured; but it is easy to balance the illuminations by the oscillations of the sector [This was experimentally demonstrated.] The light passed through is then very easily found.

Again I may use coloured paper and do the same. To myself it is more easy to balance a coloured light against a white one than a white one against the white. I need scarcely say that, first of all, the illuminations of the white surfaces are balanced, and the sector opening read before the light coming through any coloured or other body is measured. If the white surface require a sector opening of 80° , and only 40° when a body is against the aperture, half the light is transmitted.

We may often want to know the amount of light reflected from a body, and the next photometer I shall show you is used by me for that purpose. It is very similar in principle to the last. The aperture is cut as before, but instead of being covered up, it is left open to allow the coloured object to be placed in it, alongside a white square. Instead of two lights one light may be used for this photometer, a reflection being used instead of the second light. This avoids any alteration in

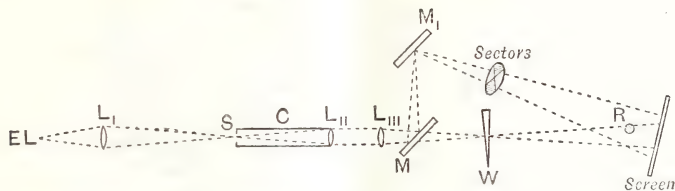


FIG. 3.

the relative intensities of the two lights used, for they both are from the same source. A rod casts shadows, one on the aperture and the other on the white square. The aperture is fitted with (say) a grey square, and the sectors in the direct beam altered till the two appear of the same colour; or I may introduce a coloured object and repeat the process. In this case, of course, first of all the aperture should be fitted with a white surface and a measure taken, and the aperture of the two measures of the sectors gives the relative brightness of the two objects.

There are often cases where we may wish to measure bodies which only allow but very little light to pass, though they are transparent. In such a case we have to use a very powerful light, and it may be that the body varies greatly in absorption at different parts. For this reason I use the electric arc light as the source, and concentrate it so as to give a brilliant beam. There are, however, variations in the electric (arc) light from time to time, and unless the comparison light, with which

the relative intensities passing through different parts of the wedge are measured, varies at exactly the same time and in the same proportion, the measurements will often be very much out. If we merely wish to measure the white light transmitted, the apparatus to employ is not very extensive, and Fig. 3 will show what it is. EL is the electric light, placed in a lantern or box of some kind, to prevent the room, which should be slightly darkened, from being flooded with light. L_1 is a condenser which throws an image of the crater of the positive pole upon the slit S of the collimator C. The rays issue parallel, and are caught by a lens L_{11} , which forms an image of the slit upon the surface of the wedge, W, placed in a proper position and in its mountings. The light, after passing through the wedge, forms a circle of light on the screen. It will be noticed that the image of the slit may be as narrow as one wishes by opening or closing S, and that we have a line of light passing through the wedge, such as is required to effect the graduation. Calculation

will show that, with a fairly narrow slit, the measured intensity passing through it may be taken as that passing through the mean thickness of that part on which the image falls.

Placed in the path of the beam, and between the wedge and L_{III} , is a plain mirror, M (for which I often substitute a prism of $1\frac{1}{2}^\circ$, and so obtain a single reflection), which reflects the light at right angles, or any convenient angle to its path. It is again reflected from M_1 , a silver on glass mirror. An image of the slit is formed in the path, and a second disc is formed on the screen. The centre of this disc is made to coincide with the centre of the disc formed by the light passing through the wedge. A rod, R , is placed in the path of the two beams,

which casts two shadows, one illuminated by one beam and one by the other. The usual black mask is used on the screen, to confine the attention to a small part of the shadows.

It will be seen that, when any variation takes place in the light, it equally affects both the illuminated shadows; hence the measures may be made without fear of error creeping in. Sectors with apertures, moving at will whilst they are rotating, are introduced, as shown in the figure, and sometimes a second set of fixed sectors are introduced between M and W should the light passing through W be too bright. The screen is placed perpendicular to the line bisecting the angle made by the two beams. It should be noted that this plan almost necessitates movable sectors, but

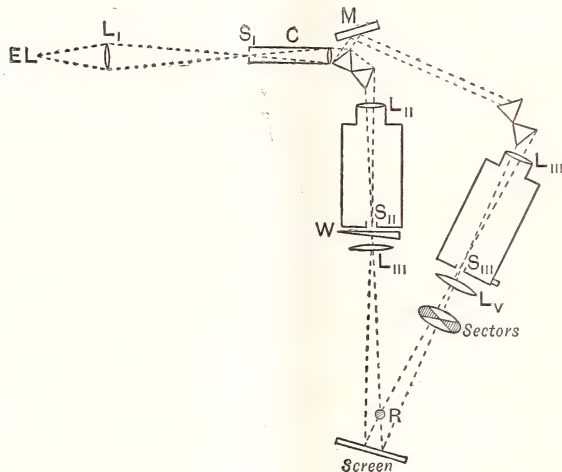


FIG. 4,

sectors which are fixed at known apertures can be used at a pinch, and the balance made by moving the wedge in its settings.

It should be remarked that though the wedge may not be pure black the readings can be very readily made by the method of oscillating between "too light" and "too dark" for the shadow whose brightness is controlled by the sector. In making a valuation of the wedge, the first thing to do is to compare the lights without the intervention of the wedge, and then to take readings.

For certain purposes it is necessary to know how much of each colour of the spectrum is transmitted through a wedge, and Fig. 4 shows how this is accomplished.

The electric light and the collimator are placed as before, but the parallel emergent

rays fall upon a pair of prisms, and the spectrum is brought to a focus by L_{III} on to a screen in which there is a slit against which the wedge in its setting is placed. The slit can be placed in any spectrum ray, and the wedge surface is always kept perpendicular to that ray. A lens, L_{III} , brings the rays to a focus, so that a monochromatic image of the surface of the last prism is formed on the screen. From the surface of the first prism parallel rays are reflected: these are caught by a mirror and fall on a pair of precisely similar prisms, and the remainder of the apparatus is exactly the same as that described above, a second patch of coloured light being formed over the first patch. The slit, S_{III} , is so adjusted in the spectrum that the two patches are of the same colour. The

sectors are placed as shown in the figure, the rod, R, forming two shadows, as before. The method of procedure is to place the slit, S_{11} , in some colour in the spectrum, and S_{111} in the same. The wedge is then graduated for this beam throughout its length, another position is taken up, and the same process gone through. By this means we get the logarithmic factor of transparency for each part of the wedge for the whole of the spectrum colours.

The last point that I shall have to refer to is an apparent failure of the law of inverse squares as regards photometry.

I have upon the screen two patches of spectrum light—a red and a green—of equal intensity, if anything the red is rather the brighter. I place the rotating sectors in front of them and gradually close them. Notice that the red begins to fade away much more rapidly than the green. When very nearly closed the red has disappeared and the green remains not of its light green colour but as a green grey.

Let us argue from this what should result. If when we illuminate a screen with red light we can remove it to such a distance that the screen becomes invisible, though if we have green light, which appeared of equal brightness when close to it, we should be able to remove it much further before the same screen became invisible. The point at which the screen disappeared from view would evidently be the zero point from which the illumination would have to be reckoned for the colour which was used. So with white light, there is a point at which the screen would become invisible. Evidently then the law of inverse squares for illumination appears to fail for low intenseness of light, and this is owing to the insensitiveness of the eye. Theoretically, of course, the screen may be moved to an infinite distance and still be visible. The law is obeyed practically of course. It may be thought that this limit of vision is of no practical account. But I must say that it is. For instance, in the photographic room we use red light, and we find that the corners of a fairly-sized room are invisible. If we use canary medium the corners will be well illuminated. This is owing to what I may call the superior space penetrating power of illumination of the yellow-greenish light over the red.

I have not been able to show all I wished owing to want of time, but I trust that what I have shown may not be lacking in instructiveness.

Miscellaneous.

SECONDARY EDUCATION IN SWITZERLAND.

Her Majesty's Consul at Zurich, in a recent report, has given an account of the secondary school of the canton of Zurich, which is justly considered a model establishment. This school follows on the sixth year of the primary school and has a three years course. The pupils are twelve years of age when they enter and fifteen years of age when they leave. It is a connecting link between the primary school and the technical side of the cantonal school, and is besides intended to complete the education of those who on leaving it are not in a position to attend a higher school. The Zurich secondary schools were founded in the year 1833 after the Cantonal Government had passed a law authorising the establishment of higher people's schools. According to the text of the law the following subjects were to be taught:—Religion, German and French languages, arithmetic and geometry, history and the Swiss Constitution, geography and natural science (especial regard being had to agriculture and manufactures), singing, drawing, and calligraphy, and practice in reading. The instruction in other languages, besides those above-mentioned, and in special sciences and arts, might be connected with the secondary school, but the attendance in these cases was not to be compulsory. Every child after leaving the ordinary day-school could, on passing the examination, enter the secondary school. The school fees were 16 francs (12s. 8d.). The course was to last for three years with thirty-three lessons a week. In order to facilitate the attendance at these schools, the canton of Zurich was divided into fifty school districts. Each secondary school district received from the State a subvention of 600 francs (£24). A school district was allowed to open its school as soon as the salary of the teacher, so far as it was not covered by the State subvention, was assured by a school fund, or by annual contributions and guaranteed school fees for at least six years. A great obstacle at first was the dearth of properly trained secondary teachers. The minimum annual salary for the 33 compulsory lessons was fixed at 960 francs (£38), besides free dwelling or corresponding compensation. Every candidate for a teacher's place had to present himself for examination before the Board of Education. The teachers at first received their training at the teachers' seminary at Kussnacht, near Zurich, where they studied for four years, generally passing afterwards half a year in French Switzerland to perfect themselves in French. At the present day, a young man wishing to become a secondary teacher has, on leaving the secondary school, to study for four years at the teachers' seminary, and then pass the examination required for teachers of primary schools. After this he must study for two years at a

university, and then pass another examination before he can obtain his certificate as secondary teacher. At present the instruction at the secondary schools in the whole canton is gratuitous. In all the secondary schools of the town of Zurich the necessary school books and writing materials are supplied to the pupils free of charge. The sexes are separated in the schools in Zurich and Winterthur, and in one parish on the lake of Zurich; at all the other secondary schools in the canton boys and girls receive instruction in common. Two-thirds of the legal minimum salaries of the secondary teachers are paid by the State, and one-third by the commune. The State pays each secondary teacher 1,200 francs (£48), the Commune 600 francs (£24); besides this, in the country, the teacher has dwelling, wood for fuel, and vegetable garden free, or receives an equivalent in money. In the town of Zurich, the minimum commencing salary of a secondary teacher is 3,400 francs, with a rise every five years of 250 francs (£10), till, after 20 years service as a teacher, the maximum of 4,400 francs (£176) is reached. In the country, somewhat more than the half of all the communes in the canton of Zurich give the teachers additional pay beyond the legal minimum mentioned above. The amount of this addition ranges from 300 francs (£12) to 1,000 francs (£40) per annum. Teachers who, after at least 30 years service, retire, with the consent of the Board of Education, on account of old age or the state of their health, are entitled for the rest of their lives to a pension, which must be equal to at least half of the pay they have hitherto received, and the amount of which is fixed, in each individual case, by the Board of Education, regard being had to the circumstances in question, *e.g.*, the number of years of service, the pecuniary position of the teacher, his efficiency, &c. The pension for the widows and orphans is formed by the teachers paying 40 francs (£1 12s.), and the State contributing 36 francs (£1 8s. 9d.) a head per annum. The widows receive a pension of 400 francs (£16 a year).

NORWEGIAN WOOD-PULP INDUSTRY.

The *Board of Trade Journal*, quoting from the "Bulletin du Musée Commercial," reports that the year 1893 was a very favourable one in Norway for manufactures of wood-pulp, the prices having on the average been four kroner (4s. 5½d.) higher for wet pulp, and eight kroner (8s. 10¾d.) higher for dry than they were in the preceding year.

At the commencement of the year the quantities sold amounted to 130,000 tons. The demand having again increased, the wood-pulp syndicate realised that the reduction of the production to the extent of 33½ per cent., which was primarily fixed upon, was too great, and at a meeting which was held in May the maximum reduction was fixed at 23½ per cent., but in spite of this prices continued to rise. Towards the

end of the year small quantities which were available were sold at 55 kroner (£3 1s. 1¾d.) and 100 kroner (£5 11s. 1¾d.) per ton respectively for pulp wet and dry.

For the current year the greater part of the production is already sold at remunerative prices. The improvement which has manifested itself in the Norwegian pulp industry has led to the very considerable extension of the factories already existing and to the construction of new works in Sweden and Norway.

The home consumption has remained almost stationary; in England the consumption has increased, and also in France. As regards Germany, this country imported, in 1893, 10,000 tons of Norwegian wood-pulp more than in 1892, but this increase was in great measure due to the dryness of the season last year. At the present time there are 59 wood-pulp factories in Norway; of this number one is engaged in the manufacture of casks, three manufacture cardboard, and ten paper.

The quantity of wood-pulp exported from Norwegian ports, that is to say, the Norwegian product, and a certain proportion of Swedish pulp, amounted in 1893 to 230,000 tons, as compared with 215,000 tons in 1892, and 207,000 tons in 1890. The above observations and figures all relate to mechanical wood-pulp.

As regards chemical wood-pulp, the increase in the demand created in 1892 by reason of the restrictions effected in the rag trade continued in 1893, and the results of that year have been equally favourable to that industry. The prices in 1893 of dry chemical pulp quoted by the Norwegian manufacturers were as follows:—First-class dry sulphite, from 200 to 210 kroner (£11 2s. 2¾d. to £11 13s. 4d.); second-class from 185 to 195 kroner (£10 5s. 6¾d. to £10 16s. 8d.) per ton. First-class sulphate pulp was quoted at from 180 to 190 kroner (£10 to £10 11s. 1¾d.) and second-class from 170 to 180 kroner (£9 8s. 10¾d. to £10), but these prices are with difficulty obtained. It is said that the prices of pulp will fall, while those of the raw material will rise.

TRADE OF COREA.

The trade of Corea employs, as its medium of exchange, the *yen*, or silver dollar of Japan, and the copper cash of the country. In the year 1893, the total value of the foreign trade amounted to \$7,778,055, against \$9,669,400 in 1892, and \$10,249,209 in 1891. The trade was divided among the three ports, Chemulpo, Fusan, and Wönsan, in the following proportions: Chemulpo \$3,976,885, Fusan \$2,323,741, and Wönsan \$1,477,429. At the first of these ports the value of the foreign imports was \$2,045,607, the native imports \$1,167,529, and exports \$763,749; at Fusan the figures were respectively \$804,884, \$310,963, and \$1,207,894; at Wönsan \$650,269, \$301,787, and \$525,373. The value of the *yen* fell, in 1893, from 3s. to 2s., and

the mean between these sums may be assumed at a fair average rate for the year. Estimated in this way, it appears that the total foreign trade of Corea for 1893 amounted to £972,507, as against £1,450,410 in 1892, and £1,708,202 in 1891. Consul-General Wilkinson says that the causes of the diminution in 1893 were ascribed partly to the unsettled political condition of the country, but chiefly to the great damage done to the crops by heavy storms. The principal exports of Corea are rice, pulse, fish, hides, skins, native cotton, seaweed, sharks' fins, *bêche-de-mer*, bones, paper, wheat, barley, and nutgalls. Corean rice is always in demand in Japan, not only to meet the actual requirements of that country, but also to supply the place of the rice exported thence to Europe and America. The destination of almost all the pulse that leaves Corea is Japan, where beans are used in the preparation of soy, and of a local condiment known as *miso*. As is also the case with rice, a certain proportion of the Corean beans finds its way from Japan to other countries. The fish exported comes generally from the ports on the east coast, Fusan and Wönsan, the exports at Chemulpo being insignificant. One great fishery is that of sardines, which, however, instead of being prepared as an esculent, are disposed of to the Japanese in the form of manure. The catch of this fish appears to be greater each alternate year. Consul Wilkinson says that on her fisheries lies a great source of wealth for Corea, but, so far, the profits have gone to the Japanese. The Coreans are averse to the hardships of a fisherman's life, and when they do exert themselves sufficiently to make a haul, cannot take the trouble to properly prepare the fish for the market. A curious feature in the Corean export trade in hides is that it always varies directly with the prevalence of cattle plague: the greater the amount of rinderpest, the more hides for sale. Most of the skins go to Japan, there to be made into foot gear, but some find their way to Newchwang, as coverings to the stove beds. One of the noticeable circumstances in the trade of 1893 was the large increase in the export of native cotton from Fusan. Under this head is included both raw cotton and cotton goods of native manufacture. The greater part of the former goes to Japan, whence it often returns to Corea in the form of wadding for clothes. The latter, in 1893, went almost entirely to Wönsan, where they competed successfully with their Manchester rivals. Corean cotton cloth is much coarser in texture than its foreign rival, but is considered more durable, and it is all woven by hand. Fusan is the chief port for the export of seaweed, and Osaka is the principal port of consumption. The importance of the paper-making industry is well understood in Corea, where the *Hibiscus Manihot*, which is a plant used for sizing the paper made from the bark of the *Broussonetia papyrifera*, or paper mulberry is found. The export of paper from Corea has of late shown a decided increase, while the manufacture is extensively carried

on as there is a great demand for it owing to its toughness and durability. Paper is the only one native article manufactured in Corea which is exported in any quantities to the neighbouring country of China. It is in general use there for the papering of rooms and windows, as in Corea. The manufacture of a coarse kind of paper for pasting on floors instead of carpets, for making lanterns, conical rain hats, and for boxes and trunks, is carried on outside the north gate of Söul in a valley through which runs a stream. Old rags and paper of all kinds are brought out from the city, and first placed in a large tub at the side of the stream, where they are thoroughly washed and all the dirt and ink is beaten out of them. The clean materials are then carried to a long wooden trough where they are stamped into a pulp by men who trample on the mass much in the same way as the juice is pressed out of the grape in France and Spain. The water is then allowed to run off, and the white pulp is thrown into a large wooden tank full of water, slightly warmed in winter to prevent it freezing. After the pulp has soaked for an hour or two the workmen take a bamboo mat about four feet long and three feet broad, which they place on a wooden frame and dip into the tank, one person standing on each side. The frame is almost immediately taken out again, covered with a thin layer of white pulp, which is thrown neatly on a cloth at the side. The bamboo mat is then peeled off so as to leave a smooth sheet of pulp behind. The frame is again dipped in, and another sheet is thrown on top of the first one, and so on until there is a pile several feet in height. The sheets of pulp are then laid out in bundles to dry in the sun. When sufficiently hard, the sheets are cut up into small strips and placed in another wooden tub, preparatory to being worked over again. The second process is exactly the same as the first, except that the roots and seeds of a certain plant called *takpool*, or starch wood, are put into the water to make it glutinous, and thus render the paper tough and durable. When the sheets are almost dry, they are taken singly and spread out on a flat slab of granite, where men with large wooden mallets beat the paper to the requisite thinness. For the thicker kinds several pieces are beaten together. The sheets are again dried in the sun, and they are then ready to be folded and taken to the paper shops. Attention has of late years been frequently drawn, in Consular and other reports, to the possibility of an export trade in human hair in Corea. All female attendants in the palace wear on their heads a heavy mass of false hair. This is stated to be of at least two qualities, according as it is derived from the clippings or from the combings of the head. The Corean youth whose hair hangs down below his waist, finds it necessary from time to time to have his locks thinned out, and the resulting hairs are preserved and twisted into tresses. A tress thus formed, of the thickness of a finger and the length of a yard, sells at from 4,000 cash to 5,000 cash (about

3s.) ; a similar tress made up from combings is worth about half that amount. The greatest quantity of hair comes from the southern provinces, but the best from Hwang-hai Do. There, it is explained, the extent of the rice fields keeps the atmosphere moist and clear of dust, so that the hair of the inhabitants is at once luxuriant and comparatively free from foreign matter. The principal articles of import into Corea are cottons, woollens, silks, and metals.

LEATHER AND GLOVE - MAKING INDUSTRY IN SPAIN.

Skins used for the manufacture of gloves in Spain are kid for the first quality and lamb for the second quality. The United States Consul at Cadiz says that the skins are placed in a limewater bath for four or five days, after which they are taken out and extended upon a bench called *caballete*, and with a curved knife that has no cutting edge, known as the *descarnador*, are depilated, then turned over, and by means of another knife of dull edge the flesh is cleared from them. After this the skins are rasped with another unsharpened knife, then stamped with a rammer and rasped again. They are then put into a bran-water bath until they float on the surface, when they are taken out and the bran removed by means of a slightly sharpened knife, which is passed over the skin from side to side. When thus cleansed they are placed in a large earthen vessel containing beaten yolks of eggs and wheat flour, and agitated for a short time, then melted alum is poured into this bath in the proportion of three pounds for every twenty-four skins. In this wash they are macerated with the feet for two or three hours, after which they are taken out washed, pressed to remove the water, and placed to dry. The skins are prepared for colouring by rasping and softening them, placing them upon a lead table and saturating them with urine or potash. Anilins are employed to produce the colours, and the brilliancy is obtained by means of polishers. Russia leather is sometimes used for making gloves. Its preparation commences like that of the common leather, by removing the grease and depilating the skins with lime. They are afterwards macerated in a bath of fermented rye flour dissolved in water, and they are kept in this bath for two days. They are then cleaned and washed in running water. The tanning is performed by employing the bark of the birch, pine or willow trees, in which decoction the skins are submerged and agitated twice a day for a fortnight and sometimes for as long as six weeks. After this they are rubbed and scraped upon easels, and once cleaned, extended on a table, and impregnated on the flesh side with the empyreumatic alcohol oil obtained by the combination of tar and birch bark, and then immediately stretched, in order to give them the necessary flexibility. Once saturated with this oil, the hair side is bathed with a solution of alum, then dried, and a fluted cylinder passed over

it. It is now ready for colouring. The red colour of Russia leather is obtained by boiling red sandalwood and logwood in limewater, containing a small quantity of carbonate of potash and oxide of sodium, which infusion is poured into sacks, formed by two skins sewn with the hair side inwards. The liquid is kept inside, until it penetrates the skin. The colour can also be applied with a brush, giving the skin continual coats of the infusion named above. When the skins are coloured, the ordinary methods are proceeded with, to soften and polish. Knapp leather is prepared by two methods: the first consists in submerging the skin in a bath containing 5 per cent. of tanning lime, where it is kept until well impregnated, then taken out and left to drip; it is afterwards placed in another bath, composed of 3 to 5 per cent. of potash soap, in which it is tanned. The second method, by which better results are obtained, consists in mixing an alum solution with the soap, thus obtaining a compound, in which the skin is kneaded; after this it is washed and dried. The knapp leather obtained by means of the alum soap has a white surface, and is soft and agreeable to the touch. White leather is prepared from kid, goat, and sheep skins, by submitting them to the preparatory operations of tanning, lime being employed for cleaning and depilation. The skins are well washed, to remove the grease, and, with the object of effecting this and of swelling them, they are placed, after being cleansed, in a bath of oat water, where they are kept for two or three days; they are then taken out, washed, and wrung out by twisting. They are then immediately put into the tanning bath, which is composed of 750 grammes of alum, 30 grammes of marine salt, and about 22 litres of water for every ten skins. To operate with it, a hot mixture is placed in a tub, and when it begins to cool a skin is submerged in it once or twice until it is well soaked, it is then taken out and the others treated in the same way. They are then placed, without drying, one over the other, and are left for two or three days. They are afterwards twisted and hung up to dry on long poles, called *pertigas*. During this drying, the skins become wrinkled and very rigid. In order to lengthen them and to remove the wrinkles, they are rubbed longitudinally against the convex part of a curved bar. The preparation of glove leather requires especial tanning, every operation being performed in an exceedingly careful manner, so that the skins may be completely cleaned, softened, and given that elasticity necessary to adapt them to the form of the hand, and to always preserve their grain intact. The preliminary operations of preparing this leather are the same as those indicated for white leather, the tanning being different. When prepared, they are introduced and macerated with the feet in a bath composed of wheat-flour, yolk of eggs, alum, marine salt, and water in a sufficient quantity to form a sort of a light paste, which acts in the following way. The flour swells the skin by the combination of its glutinous parts with the alum absorbed by it, the

yolk of the eggs acts not only by its albumen, but also by the oil which it contains, and gives to the skin the softness and resistance necessary for leather intended for gloves. Once well soaked in this paste, the skins are taken out, and, after drying, slightly moistened and stretched as rapidly as possible. They are then placed by dozens inside a cloth, and pressed by the feet, to soften them. They are then submitted to the polisher, by whom they are stretched and polished. This operator removes the last vestige of flour which may remain. They are then whipped and beaten to give them softness. When the leather is intended for the manufacture of embroidered gloves, it is polished with a glass polisher on the hair side, or covered with a light bath of albumen, Senegal gum, or soap. The French system of glovemaking is the one generally followed in Spain. For sewing the gloves, pedal machines, similar to the ordinary sewing machines, are used, and for silk sewing common embroidering frames are employed. A dozen tanned kid skins cost from about 20s. to 25s., and these will make from twenty to twenty-four pairs of gloves. A dozen tanned lamb-skins cost about the same, but will make from forty-four to forty-eight pairs of gloves.

Notes on Books.

ON THE DEVELOPMENT AND TRANSMISSION OF POWER FROM CENTRAL STATIONS, being the Howard Lectures delivered at the Society of Arts in 1893. By William Cawthorne Unwin, F.R.S. London: Longmans, Green, and Company. 1894.

The report of Professor Unwin's Howard Lectures was printed last year in the *Journal*, and, therefore, it is not necessary to give any detailed notice of this volume, which is based upon those lectures. The subject is somewhat more fully treated here, and a chapter is added on the utilisation of Niagara falls, in which particulars are given of the scheme initiated by Mr. Thomas Evershed, for the carrying out of which the Niagara Falls Power Company was formed in 1886. This volume is fully illustrated, and contains particulars of the different modes of transmitting power to a distance by means of steam, water, compressed air, gas, and electricity.

HANDBOOK OF SLÖJD. By Otto Salomon. Translated by Mary R. Walker and William Nelson. London: George Philip and Son. 1894.

THE THEORY OF EDUCATIONAL SLOYD. Lectures by Otto Salomon. Same publishers.

These two books are intended to give an account of the method of elementary technical instruction known as "Slöjd" or "Sloyd," and devised by their original author, Otto Salomon. The system, as is well known, consists mainly in teaching children

elementary carpentry, with the idea not so much of giving them true technical instruction as general manual dexterity. The first of the two books gives a full description of the method employed, tools used, and the various processes taught. The second is a translation of Salomon's lectures on the subject, and seems to be intended rather for the instruction of teachers than for use as a text-book; the last portion of the book, however, is devoted to a description of the different exercises.

SELECT METHODS IN CHEMICAL ANALYSIS (chiefly inorganic). By William Crookes, F.R.S. Third edition, rewritten and enlarged. London: Longmans, Green, and Company. 1894.

The author states that the object of this book is not that it may form a complete text-book of analysis, but rather that it may serve as a laboratory companion, containing information not usually found in ordinary works on analysis. Mr. Crookes has tested most of the new processes which have appeared of late years, and in many instances improved them. He has aimed at making his work a record of new processes, so that when a process has been widely accepted, taken its position in laboratory practice, and been described in ordinary text-books, the description in this book has been removed from the third edition in order to make room for others which have been proposed and found to be successful during the eight years which have elapsed since the second edition was published. The analyses of the several elements are set forth in thirteen chapters, chapter xiv. is devoted to electrolytic analysis and gas analysis, chapter xv. to miscellaneous processes and general methods of manipulation, and chapter xvi. to a series of useful tables. That most important portion of a book of facts—a full index—has not been forgotten.

SPEECHES AND ADDRESSES OF EDWARD HENRY, XVTH EARL OF DERBY, K.G. Selected and Edited by Sir F. H. Sanderson, K.C.B., and E. S. Roscoe, with a Prefatory Memoir by W. E. H. Lecky. London: Longmans, Green, and Co., 1894. 2 vols. 8vo.

The speeches here collected together are those which Lord Derby delivered out of Parliament, chiefly relating to social, as distinguished from political, subjects. How varied are the topics with which he dealt may be seen from the titles of a few of the speeches taken from the tables of contents:—Reading, Advantages of Study to the Mechanic, Education: its Effects on National Life; Industrial Schools, Technical Education, Secondary Education, Cultivation of Art, Organisation of Charity, Hospitals, Volunteer Movement, Sanitary Questions, Thrift, Application of Science to Manufactures, Commercial Depression, Agricultural Depression, Coffee-taverns, Free Libraries, Co-operation, Training of the Blind, Emigration, Mitigation of the Smoke Nuisance, Fruit

Culture, &c. These speeches range over a period of time from 1854 to 1891, and were delivered at various parts of the country on different occasions. Lord Derby was a member of the Society of Arts for many years, and some of his speeches were delivered at the meetings of the Society. Mr. Lecky has prefixed a short, but interesting, memoir, in which he refers to the clearness, power, and persuasiveness of Lord Derby's oratory. "He had a curious talent of making speeches with which every one must agree, and which, at the same time, were never commonplace. Their secret lay in the habit of mind that led him always to seek out the common grounds of principle or fact that underlie every controversy, and which, in the heat of the conflict, the disputants had often failed to recognise."

FORMER CLOCK AND WATCHMAKERS. By F. J. Britten. London: F. J. Spon.

Mr. Britten puts forward this book as a complement to his "Watch and Clockmakers' Handbook." In the former work he dealt with the technics of his subject; in the present he treats of the history. He commences with an account of standards of time, and the early instruments used for securing it: sun-dials, clepsydra, &c. Then, after an account of a few of the earliest clocks, he passes to the history of English horology, the great advances in which may be dated from Hooke, who certainly was among the first to apply the pendulum, an invention which Mr. Britten hesitates to attribute to Galileo. The researches of Hooke and Huyghens were turned to more practical account by Tompion, Graham, Grignon (whose clock still regulates the Society of Arts meetings in the room where he placed it), Harrison, Mudge, Arnold, Earnshaw, Frodsham, and Dent, to bring the story down to our own times. The labours of these, and of many others, are fully chronicled by Mr. Britten, who brings the narration down to the construction of the great Westminster clock by Lord Grimthorpe, in 1859, and the establishment of a system of pneumatic clocks in Paris in 1875. The book concludes with a table of Hall-marks, and a list of former members of the Clockmakers' Company, known to have been engaged in the business. In some future edition we may hope that an index will be added, an essential addition to a work of this character.

PRACTICAL DESIGNING. Edited by Gleeson White. London: George Bell and Sons. 1893.

We have here eleven short treatises by as many different authors, ten of which treat of the character and method of designs suitable for special branches of artistic manufacture, while the eleventh, by Mr. Gleeson White, is devoted to "Drawing for reproduction" by the various processes, based on photography, which have to so large an extent superseded wood-engraving. These processes have been themselves described in several books, but this is probably

the first time that careful and minute instructions have been provided for the artist whose drawings have to be dealt with by them. How many points there are for him to consider, and how greatly the work of reproduction will be facilitated by careful attention to those points, will be appreciated by a study of Mr. White's article. In all the other papers the object of the writer in each case has been to indicate the limits enforced on the artist by the nature of the material for which he has to work, and the character of the manufacturing process by which his design has to be reproduced. A design must not only be suitable in an artistic sense, it must be capable of production, and the main intention of this handbook appears to be to enable the young designer to produce work directly available for its intended purpose, without the need of the intervention of an expert to translate it into a technical possibility. The several papers cover designing for textiles, wall-papers, and floor-cloths, pottery, stained glass, metal-work, and bookbinding. The following are the subjects and the names of the writers:—Carpets, by R. Millar; Woven Fabrics, Printed Fabrics, and Floor-cloths, by R. Silver; Pottery, by W. P. Rix; Tiles, by V. Carter; Metal Work, by R. L. B. Rathbone; Stained Glass, by S. Image; Bookbinding, by H. Orrinsmith; Wall-papers, by G. C. Haité.

General Notes.

STRASBURG EXHIBITION.—An Industrial Exhibition, confined to the manufactured products of Alsace-Lorraine, the Grand Duchy of Baden, and Rhenish Bavaria, is to be opened on the 15th May, 1895, and will remain open until the 15th October.

GOLD IN NEW SOUTH WALES.—A recently published return from the Sydney Royal Mint shows the gold yield of the colony for 1893, as compared with that of previous years:—The total output for coinage in 1893 was 171,097·07 oz., as against 144,259·48 in 1892, and 142,470·23 oz. in 1891, showing an increase over 1892 of 26,837·59 oz. The gross value for 1893 (for coinage) was £619,071. The western district yielded, in 1893, 54,896·03 oz., as against 50,754·83 oz. in 1892, and 45,622·23 oz. in 1891. The southern district gave 28,001·35 oz. in 1893, as against 23,118·10 oz. in 1892, and 24,506·80 oz. in 1891. The northern district produced 44,893·27 oz. in 1893, as against 43,791·59 oz. in 1892, and 39,651·99 oz. in 1891. Localities returned as unknown contributed 42,326·40 oz. in 1893, as against 26,594·96 oz. in 1892, and 32,698·91 oz. in 1891. It will be seen that each district shows a material increase in the output, as judged by the quantities sent to the Sydney Mint for coinage.

Journal of the Society of Arts.

No. 2,177. VOL. XLII.

FRIDAY, AUGUST 10, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS, 1895.

The dates fixed for the Society's Examinations in 1895 are—Monday, March 25th, Tuesday, 26th, Wednesday, 27th, and Thursday, 28th.

The arrangements of the time table, the subjects, and the prizes offered, correspond with those of the last Examination.

The Programme of Examinations will be ready shortly.

PRIZE FOR DESIGN FOR A SILVER CUP.

The Council of the Society are prepared to award a prize of £25 for the best design for a silver cup. The design, if adopted, will be used for the Swiney prize, which, under the will of the late Dr. Swiney, is awarded every five years by the Society for "The best published work on Jurisprudence." The value of the cup is £100. The offer is open to all students of schools of art in the United Kingdom. Competing designs should be sent in not later than the 31st December, 1894, addressed to The Secretary, Society of Arts, Adelphi, London. They may be sent in under a motto, or in the competitor's name, as preferred. Any design for which the prize of £25 may be awarded will become the property of the Society, to be used as the Council of the Society may direct. The Council reserves the right of withholding the prize, or of awarding a smaller amount, if it should see fit.

Miscellaneous.

THE MANUFACTURING INDUSTRIES OF INDIA.

During the last 20 years, the number of iron foundries and machine shops has greatly increased in India, and the country is less dependent on Europe for general ironwork; importations of wrought iron and steel are yearly increasing. The following is a list of such structures of iron and steel as are built in India:—Coasting and river steamers, launches, barges, steam boilers, bridges, tanks, piers, and jetties, sluice gates, buildings, engines, steam pumps, turbines, sugar-crushing machinery, oil mills, cotton, hay, and other presses, and grinding mills. The United States Consul at Bombay says that the railway companies build their own rolling stock, but they import the wheels, axles, tyres, and other ironwork; rails also are imported, as are also steel sleepers, which are much in vogue in place of timber, Bolt, chain, and rivet making are not yet known as separate industries. Wire working is a steadily-increasing industry, being readily taken up by the natives. Locks, of fairly good quality, are made in Bombay and Calcutta, but none of the manufacturers appear to possess a key-cutting machine, or a good set of machine tools. On account of national and religious customs, brass and copper vessels, for cooking, eating, and drinking are to be found in every house, and the workers in these metals are more numerous than those in iron. The hollow ware is made of imported sheets, hammered into shape; vessels used for cooking are tinned inside; brass hinges are made and much used on account of the destructive effects of the monsoon rains on iron hinges; the whole of the work is done by hand, without the assistance of any stamp or press. Machine tools are made, but in small quantity, most of the tools being imported. Textile machinery is entirely made in England. Agricultural implements are in small demand, on account of the poverty and ignorance of the cultivators. Cultivation, as practised in Egypt, the grain districts of Southern Europe, and the United States has not yet been begun in India. India possesses only one glass factory conducted on European methods, and this is in Calcutta. There are a few smaller glass factories, but when they do not use broken imported glass, they turn out goods of an inferior quality. Most of the broken glass that reaches the ports of India is sent to China, where it is worked up by the Chinese glassworkers. Good glass-making materials are to be found in India, and a factory for the manufacture of soda water bottles alone would, according to Consul Sommer, find occupation for a large number of operatives. Window glass is now largely used throughout India, where only shutters were used before. It is obtained principally from Belgium. There are five woollen

mills in India, two of which are in Bombay. The materials made are blankets, heavy coatings, serges, and uniform cloths. Both Indian and Australian wools are used, and the future of this industry promises to be a prosperous one. There are nine paper mills in India, four of which are in Bombay. The fibrous materials used for making paper are chiefly rags and munj grass, rice straw, jute and hemp cuttings, and old jute bags and cloth. The quality of the paper made has improved in recent years, and there is a large and increasing sale of this product. The production of paper in India has increased 118 per cent. since 1885, amounting to 11,086 tons in 1891. It is expected that India will in a very few years, supply its own paper, the only drawback being the cost of transportation of raw materials from great distances. There were twenty-six mills working jute, and one working hemp in India at the end of the year 1891-92. The mills contain 8,695 looms, and 174,156 spindles. Their nominal capital is estimated at £1,760,000. In brick and tile-making there are few factories having the appliances for making bricks by machinery. The tiles most in use are of native design and manufacture. A tube of clay is spun by hand on a very simple wheel made of wood and balanced and loaded with clay. It turns on a peg, and having been set in motion, it revolves long enough for the operation. The tube which is tapering in form and about four feet long by four inches and a half wide, is split by a piece of string into halves, which when dried and burned, become the country tiles of India. One layer with edges up and one layer with edges down is what is termed a single tiling. No fastenings are used, there being only one support at the eaves of the roof to prevent them from slipping off. In large towns the European pattern of tile is coming into vogue. The greatest number of European tile factories in India are in Malabar and South Canara, where water carriage along the coast affords a cheap means of transportation. The factories are closed during the rainy season. The silk industry has not shared the prosperity of the cotton and woollen industry, for while the exports in 1869-70 amounted to 2,594,701 pounds. The exports in 1891-92 were only 1,782,438 pounds. There is a silk mill at Bombay which works only for the Burmese market; and does not venture to compete with the European and Asia Minor goods. Thana, near Bombay, used to have a thriving trade in woven figured silks, which were famous for their qualities of dye and purity, but it has now lost most of its trade owing to European competition and a growing demand for cheap goods. There are 113 silk factories in India. The first ice factory in India was built at Agra. There have been since thirty-four factories built throughout India. There are large numbers of soda-water factories; in 1891, there were 76. Many of the smaller factories use water from stagnant wells and pools, and some filters are never cleansed, thus giving a bad taste to the soda. Many natives use the carbonic acid to

make spurious champagne and other sparkling wines. Oil has been expressed for many centuries by the *ghanee*, a mortar, having a revolving pestle driven by hand or bullock power. The residual cake contains a large quantity of oil, and is used as food for cattle. This mill is still in general use, excepting where Europeans have a hand in the production, European machinery, of course, giving better results. Until six or seven years ago, vegetable oils were almost exclusively used for every kind of lubrication in India. At first mineral oils made a bad impression, but this was soon removed. *Ghee*, a clarified butter used by the natives, is adulterated with vegetable oils and animal fats.

DEPARTMENT OF COMMERCE IN THE UNITED STATES.

The last number of the *Board of Trade Journal* contains an article on the movement on foot in the United States to establish in that country a Government department corresponding to the British Board of Trade, and performing similar functions, from which the following particulars are taken:—

The Commissioner of Navigation at Washington, in a recent report to the Secretary of the Treasury, says that the Bureau of Navigation was organised by an Act of Congress of July 5th, 1884, for two purposes. First, to collect under one head several official duties performed in different bureaux of the Treasury, and, secondly, to relieve the Secretary of the Treasury of oppressive ministerial and administrative duties; but the framers of that law clearly intended that it should constitute the first step in what must result in an important organisation of Government offices relating to commerce, transportation, navigation, and marine interest, so as to group all Government functions relating to these subjects into one great department of the Government, corresponding to the British Board of Trade, and presided over by a secretary. In the opinion of the Commissioner, the time appears now to have arrived when a department of commerce performing the same service to commerce and navigation as is performed with reference to the same subject by the Board of Trade in England, ought to be established.

The Act of July, 1884, referred to above, charged the Commissioner of Navigation with the following functions. The issuing of marine documents to vessels, *i.e.*, registers, enrolments, and licenses, the admeasurement of vessels, the assignment of signal letters, the designation of official numbers, the collection of tonnage tax, and the refund thereof when collected erroneously, the publication of an annual list of vessels embodying various particulars, and the compilation and publication of statistics of shipping and navigation. The statute also provides that the Commissioner of Navigation under the direction of the Secretary of the Treasury, shall have general supervision of the commercial, marine, and merchant

seamen of the United States, so far as they are not under existing laws subject to any other offices of the Government, and that he shall investigate the operation of the laws relating to navigation. Under these provisions of law a great variety of subjects is referred for consideration to the Bureau of Navigation. These embrace such questions as arise through controversy with foreign Governments regarding their vessels in United States ports or United States vessels in foreign ports, also questions in regards to the fisheries, seamen, &c. In many cases relating to fines, penalties, and forfeitures, changes in the names of vessels, compromises of claims, &c., the decision depends almost absolutely upon the discretion of the Commission.

For many years the National Board of Trade and several of the chief commercial bodies in the United States have advocated the creation of a department of commerce, and this measure has also been repeatedly recommended in Congress. When the Bill creating the Bureau of Navigation was referred to the Secretary of the Treasury for his opinion, that officer replied :—"The prospective growth of our commerce and navigation is likely in a few years to involve in their supervision so many details as to be beyond the direct control of the Secretary of the Treasury, in so far as he is now charged with the administration of the laws relating thereto."

After dealing with the organisation and scope of the British Board of Trade, the Commissioner of Navigation refers to the consideration of what would be involved in the organisation of a similar establishment of the United States executive government, and gives an account of the various offices of the Government which have to do with the internal and foreign commerce of the country, its internal transportation and navigation, and its marine interest. The following is a statement of these offices, together with the amounts of money appropriated for carrying on their operations during the fiscal year ended June 30th, 1893. These amounts have been converted from the original into English currency.

Under the Treasury Department:—Lighthouse Board and Establishment, £527,321; Steamboat Inspection Service, £65,131; Marine Hospital Service, £134,413; Life-saving Service, £234,652; Bureau of Navigation, £5,371; Coast and Geodetic Survey, £97,025; Bureau of Statistics of Internal and Foreign Commerce, £9,940; Seal and Salmon Fisheries of Alaska, £3,948; Seamen Shipping Service, £12,610; Shipping Commissioner, £11,044; and the Immigration Service, £47,703; making a total for the Treasury Department of £1,148,158. Under the State Department:—Bureau of the American Republics, £6,250. Under the Interior Department:—The Railroad Commission (Pacific Railroads), £3,338. The War Department:—Improvement of Rivers and Harbours, £4,597,545. The Navy Department:—Hydrographic office, £19,050. Offices not in any of the great depart-

ments:—Fish Commission, £68,323; Interstate Commerce Commission, £46,875; and Intercontinental Railway Commission, £13,542; making a total for the independent offices of £128,740, and a grand total for the whole of the above-named offices of £5,903,081.

The following is the description given by the Commissioner of Navigation of the general scope and character of the offices included in the above list:—

The amount appropriated for the improvement of rivers and harbours is the largest in the foregoing statement. For the year 1893 it amounted to £4,597,545, and for the last ten years to the enormous total of £24,194,310. Appropriations for the improvement of rivers and harbours have been, it is said, the result of a struggle in Congress as between sections, States, and congressional districts, and not of any systematic plan wrought out upon the basis of the commercial needs of the country.

At present it does not appear to be the duty of any officer of the Government to procure and lay before Congress the systematised statistics concerning the course and magnitude of the United States internal commerce, necessary to enable Congress to pass judgment upon the merits of the various plans annually submitted for the improvement of rivers and harbours and transportation routes to the seaboard. Expenditures for the improvement of rivers and harbours have been made under the financial supervision and engineering direction of the chief of engineers of the War Department, but that officer has never assumed any responsibility for the manner in which such appropriations should be made, nor has he deemed it his duty to report upon the relative importance of the commercial claims of sections, States, or localities. That appears to be a duty naturally devolving upon a well-devised department of commerce.

The Coast and Geodetic Survey is charged with the survey of the Atlantic, Gulf, and Pacific coasts of the United States, including the coasts of Alaska; of rivers to the head of ship navigation; deep-sea soundings, temperature and current observations along such coasts, and of the Gulf and Japan streams; magnetic observations; determination of heights by geodetic levelling, and of geographical positions by lines of transcontinental triangulation, which, with other triangulations and observations for latitude, longitude, and azimuth, connect the work on the Atlantic with that on the Pacific. The results are published in annual reports, tide tables, bulletins, monthly notices to mariners, and various charts. As the services performed by the Coast and Geodetic Survey are mainly for the benefit of commerce, it appears that its proper place is in a department of commerce.

The Hydrographic office is under the direction of the Bureau of Navigation of the Navy Department, and attends to the collection of foreign surveys, publication of charts, sailing directions, and nautical works, and the dissemination of nautical and hydro-

graphic information to the navy and mercantile marine.

The duties of the Lighthouse Board are prescribed by section 4,658, Revised Statutes, which provides that "the Lighthouse Board shall be attached to the office of the Secretary of the Treasury, and under his superintendence shall discharge all administrative duties relating to the construction, inspection, and superintendence of lighthouses, light-vessels, beacons, buoys, sea-marks and their appendages, embracing the security of foundations of works already existing, procuring illuminating and other apparatus, supplies, and materials of all kinds for building, and for rebuilding when necessary, and keeping in good repair the lighthouse, light-vessels, beacons, and buoys of the United States; and shall have the custody of all the archives, books, documents, drawings, models, returns, apparatus, and other things pertaining to the lighthouse establishment."

The Life-saving Service is designed for the more effectual preservation of life and property on the dangerous parts of the coast of the United States. It is the duty of the General-Superintendent to supervise the organisation and government of its *employés*; to fix the number of stations and of surfmen, with their compensation; to prepare estimates for the maintenance of the service, and for its extension when needed; to ascertain the means, inventions, &c., employed in foreign countries, and to adopt such of them as may appear meritorious; also to collect statistics of marine disasters, and to prepare an annual report of the work, expenditures, and property of the Service for submission to Congress.

The Supervising Inspector-General of Steam Vessels superintends the administration of the steamboat inspection laws, presides at the meeting of the Board of Supervising Inspectors, receives all reports, and examines all accounts of inspectors.

The Supervising Surgeon-General of the Marine Hospital Service is charged with the supervision of the marine hospitals and other relief service, and the care of sick and disabled seamen from merchant vessels and from vessels of the Revenue, Marine, and Lighthouse Board. Under his direction pilots, before being licensed, are examined for colour-blindness; and ordinary seamen, when requested, are examined as to their physical fitness before shipment. The Supervising Surgeon-General is also charged with the duty of framing regulations for the prevention of the introduction of contagious diseases from foreign countries, and with the direction of the laboratories established to investigate the cause of such diseases. In obedience to the interstate quarantine law he is required to prepare such regulations, under the direction of the Secretary of the Treasury, as may tend to prevent the spread of certain contagious diseases from one State to another; and to supervise the medical inspection of alien immigrants.

The Revenue Marine Service is under the control of the Secretary of the Treasury, being designed to assist in protecting the revenues from Customs.

Revenue cutters cruise in certain districts, under the direction of the collector of the port, and among other duties, see that vessels are documented as required by law. During the winter and the prevalence of storms certain cutters are employed in assisting vessels in distress.

The Interstate Commerce Commission has authority to inquire into the management of the business of all common carriers "which are engaged in the transportation of passengers or property wholly by railroad, or partly by railroad and partly by water, when both are used, under a common control, management, or arrangement for a continuous carriage or shipment." It has a general oversight of rates on interstate traffic, and institutes proceedings for the enforcement of the provisions of the law. It has power to call for reports, to require the attendance of witnesses, and the production of books and papers, to hear complaints against carriers on account of any violation of the Act, to regulate commerce, and to institute inquiries and report thereon, and to report annually to the Congress.

The Commissioner of Railroads is charged with the duty of prescribing a system of reports to be rendered to him by railroad companies whose roads are in whole or in part west, north, or south of the Missouri river, and to which the United States has granted bonds or lands, to examine their books or accounts once in each fiscal year and oftener when necessary. When required he must assist the Government directors, see that the laws are enforced, furnish such information as to tariffs for freight and passengers, and as to the accounts of said railway companies as the several departments of the Government may require, and to make an annual report to the Secretary of the Interior as to the condition of said railway companies, their roads, accounts, and affairs.

The Intercontinental Railway Commission is charged with the examination of the possible routes, and the preparation of reports as to their length, cost, and advantages, together with the conduct of proper surveys for an intercontinental railway to connect the United States of America and the other republics of the American continent.

The Bureau of Statistics publishes an annual report on commerce and navigation; annual report on internal commerce; annual statistical abstract of the United States; quarterly reports on commerce, navigation, and immigration; monthly summary of imports and exports; monthly reports of total values of foreign commerce and immigration; and monthly reports of exports of breadstuffs, of provisions, of petroleum, and cotton.

The Bureau of American Republics collects and distributes commercial information concerning those republics, and publishes translations of the tariffs of the countries of Latin America, reduced to United States equivalents, and handbooks containing the latest information respecting their resources, commerce, and general features. It also answers in-

quiries as to the commercial and other affairs of those countries, and gives to the press items of news relating to recent laws, the development of railways, agriculture, manufactures, shipping, &c.

Under the provisions of the Act of March 3rd, 1891, the general Government assumed the control of the administration of all matters relating to immigration. The office of Superintendent of Immigration was established by that Act. The Superintendent is an officer of the Treasury Department, under the control and supervision of the Secretary of the Treasury, to whom he is required to make reports as to the transactions of his office.

Services rendered by Shipping Commissioners in engaging and discharging seamen are paid from an appropriation for "salaries, shipping service" and not by the owners or masters of vessels, as formerly.

An item appears in the Annual Appropriation Bill of £10,417, for the relief and protection of American seamen in foreign countries, and several amounts are also appropriated for the same purpose in the Deficiency Bill.

The United States Fish Commission is charged with the introduction of shad and fresh-water herring, for propagation into the waters emptying into the Pacific, the Atlantic, the Gulf, and the Great Lake States; and of salmon, white fish, carp, and other useful food fishes, into the waters of the United States, to which they are best adapted; and also for the propagation of cod, herring, mackerel, halibut, Spanish mackerel, and other sea-fishes. The Commission is also required to make experiments in regard to the artificial propagation of oysters and other shell-fish.

By the Act of March 2nd, 1892, the erection of dams, barricades, and other obstructions in any of the rivers of Alaska, to prevent or impede the ascent of salmon or other anadromous species to their spawning grounds is declared unlawful, and the Secretary of the Treasury is authorised and directed to establish such regulations and surveillance as may be necessary to ensure the enforcement of the provisions of the Act, and otherwise protect the salmon fisheries.

The care of Alaska fur-seals is confided by law to a special agent, a person qualified for the service by experience and education. His duties require him to visit the various trading stations and native settlements on the seal islands, the Aleutian archipelago, the peninsula of Alaska, and the adjacent islands, for the purpose of collecting and reporting to the Secretary of the Treasury all possible authentic information upon the present condition of the seal fisheries of Alaska, and the effect and extent of whatever injury has been inflicted upon them by pelagic sealing.

SILK ASSOCIATION.

The Silk Association of Great Britain and Ireland have issued their report for the year ending 30th

April, 1894, in which it is stated that:—"The energies of the Association have been principally directed to the necessary preparations and arrangements in connection with the National Silk Textile Exhibition. The Exhibition was held, by the kindness of the Duke and Duchess of Sutherland, at Stafford-house, London, and was opened on May 8th, 1894, by H.R.H. Princess Mary Adelaide, Duchess of Teck. The object of the Exhibition was to show the ladies of the country the present state of excellence of the British silk manufactures, and that silk fabrics in every way suitable to their requirements, for dress and upholstery, in price, style, and variety, can be, and are, manufactured in this country. The Exhibition has proved an unqualified success in drawing the attention of the public to the proficiency and taste of the British silk manufacturers, and has led, at the close of the Exhibition, to the purchase, by the principal London distributors, of a large quantity of silks from English manufacturers. It has had the important advantage of securing the adhesion of the principal distributing firms in London, and also several of the leading Court dressmakers. The expenses attending the Exhibition were £974 6s. 10d., against total receipts of £820 12s. 6d., leaving a deficit of £153 14s. 4d." Respecting technical instruction, the report goes on:—"The continued efforts which the Association have made to secure adequate technical instruction in the various branches of the silk industry are bearing fruit in various directions, and notably in the practical suggestions of the Technical Instruction Committee of the Lancashire County Council and of the Manchester Corporation, by which means are being taken to establish in Lancashire, and most probably in Manchester, a thoroughly equipped school for teaching silk technology and design."

THE QUICKSILVER MINES OF TUSCANY.

The quicksilver mines of the district of Monte Amiata rank amongst the most valuable and important mineral resources of Tuscany. Monte Amiata is situated in the province of Grosseto, between the valleys of the Rivers Orcia, Fiora, and Paglia. It is distant from Siena about 36 miles, and about the same from the headland of Monte Argentario. Consul Chapman, of Leghorn, says that from the latter locality Monte Amiata forms the most noticeable feature in the distant horizon, with its summit snow-capped for most part of the year, rising from amidst the surrounding mountains to an altitude of 5,687 feet above the level of the sea. The base occupies an area of about 120 square miles. Situated almost in the centre of the Maremma, where malaria is present in the summer, Monte Amiata, from its elevation, enjoys a salubrious climate. Chestnut trees are extensively cultivated, the fruit forming a staple article of food to

the labouring classes of the district. The quicksilver mines are situated to the south-east of the Monte Amiata, near the village of Castell' Azzara, at a distance of about 12 miles from the Lake of Bolsena. Writers on the subject have pointed out that the presence of cinnabar, the ore of quicksilver, was clearly known to the ancient Etruscans, as the frescoes in the rock tombs of the ancient cities of Saturnia and Sovana, and the vases found therein, prove the red pigments used being derived from cinnabar. Moreover, the discovery made in the well-known mine of the Siele of steel implements is adduced as proof that the ore was worked during the age of flint. In 1878, when a French company was carrying on prospecting operations in Castell' Azzara, some human skeletons were found in the course of driving an adit, and close by them a gold coin bearing the inscription Philip of Macedon. These facts would point to the conclusion that the cinnabar deposits of the Monte Amiata were known, and to some extent worked, at a period of great antiquity. The revival of mining operations in the district dates from the year 1846, when the accidental discovery of some pieces of rich cinnabar in the bed of a torrent induced a speculator to acquire the mining rights over the surrounding lands, and subsequently to form a small company for the purpose of searching for quicksilver. In the year 1866 the Siele mine produced only 58 cwt. of quicksilver, of the value of about £600, but gradually the yield increased, until, in 1876, the production reached 1,908 cwt., while in 1890 the Monte Amiata district produced 8,837 cwt., of which quantity five-sixths must be credited to the Siele mine, the balance being the production of some mines in the same district of secondary importance, which were discovered in recent years. The total production of the quicksilver of Monte Amiata, during the years 1866-93, is put at 86,507 cwt., of the approximate value of £800,000, the great bulk of which has come from the Siele mine, which continues to the present day as productive as ever, according to all reports. The splendid success of this mine, while it stimulated research for the same mineral in the surrounding territory, which in some cases has met with favourable results, was also the cause of a large number of lawsuits in the Italian courts, involving disputes as to the rights of property in the mine; but prolonged litigation only proved that the title of its present proprietors could not be successfully called in question. In connection with quicksilver mining, it may be mentioned that some fifty years ago, quicksilver was discovered at a place called Capita, about twelve miles from the town of Orbetello, on the south-western boundary of the province of Grosseto. A mine was opened up under the management of a Cornish mining engineer, and for account of an Englishman. Some quicksilver was produced, but, for some reason, the work was abandoned in 1867, and continued so until 1893, when the mining rights were acquired by an English firm at Leghorn, and operations of a prospecting

character was commenced. The geological formation is the same as that of the mines of Monte Amiata, and the abundant indications of cinnabar met with so far, encourage the expectation that the mineral, in paying quantity, will be found as the workings advance.

USE OF PEAT FUEL IN GERMANY.

The United States Consul at Bamberg says, in his last report, that the numerous inquiries that have been addressed to him on the subject of cheap fuel, have caused him to give careful attention to the process by which many parts of the German Empire secure their supplies of that comparatively inexpensive, but yet satisfactory, fuel—peat or turf. Peat or turf is used throughout Europe generally, wherein the ordinary cost of its production is not materially increased by cost of transportation. In the large and small cities, as well as in the country districts, it is used for fuel; in fact, in many localities it is the only substance used for heating purposes. Peat is the product of decayed organic matter. The main cause of the transformation of vegetable substances into peat is water of a certain composition and temperature which, being almost still or flowing slowly in or above the earth, permits of the development of swamp plants, and, at the same time, preserves the latter from total decomposition, by reason of exclusion of the air. These conditions are found to exist more particularly in the temperate zone, where the necessary variations of temperature occur, and where tracts of land are found whose impervious beds lead to continual accumulations of water, while, on the other hand, other portions of territory with loose and penetrable beds, especially in regions inundated by the overflowing of rivers, are subjected periodically or continuously to an extraordinary saturation. The various theories that have heretofore been advanced to account for the origin and development of peat bogs, generally agree that the moors are the product of a more or less extensive decay of certain plants in a mass of vegetation which, under favourable conditions as regards locality, climate, and moisture, is continually being renewed in one section and matured in another. The upper layer of peat or turf, which consists for the greater part of varieties of moss, is, when broken into fragments, a loose fibrous substance—a mixture of root fibres, leaves, stems, &c. The bottom layer, known as *pechtorf* or *spechtorf* ("pitch turf"), consists of a black, compact, pitchy mass, which shrinks rapidly on being separated into small pieces. It has, when cut evenly, a smooth, wax-like surface, contains the greatest amount of nitrogen, and, consequently, is the most valuable for heating purposes. Every rational operation of peat bogs or moors must be begun by the draining of the territory to be worked, and this draining must be undertaken sufficiently in advance of the working of the peat

moor itself, in order that the territory in question may attain the requisite degree of dryness. Even after this has been effected, the peat still contains water in quantity equal to from 70 to 80 per cent. of its weight, and this remaining moisture is then almost entirely removed by successive processes of drying in the air, manipulation with machinery, or subjection to artificial heat. Until within the last few years, manual labour has been employed to work the peat bogs, but a very ingenious machine has recently been invented to take its place. This machine consists of three lancet-like knives, which, by operation of a toothed rod, cogwheel, and crank, are sunk into the peat, cutting out a square piece, which is received upon a horizontally-working shelf and removed by a simple reversing of the above-mentioned contrivance. Another method consists in ploughing and harrowing the bog or moor by the use of steam-power and wire cables, the material for which is manufactured at Mannheim. The process of drying the peat or turf, in so far as small moors are concerned, consists simply of exposure to the open air. When extensive territories are worked, artificial drying is resorted to, and the expense involved in the latter operation is by far the greatest incurred in the production of peat. In Germany the following kinds of peat are known:—Cut peat, which is cut into the form of bricks by hand spades or special machines; moulded peat, which is produced by cutting the peat moss into irregular pieces, mixing it with water and then moulding it into the respective forms; machine or pressed peat, which is the result of pressing the turf, after previous separation into pieces and drying in ovens. In the category of "machine peat" is also included the so-called "ball peat" (*kugeltorf*)—globes of turf about four inches in diameter, made by passing the turf pulp through specially contrived appliances. In the district of Bamberg, the moor to be worked is first freed from vegetation, levelled, ploughed, and harrowed, and the loosened peat broken, so as to be exposed to the action of the air. It is then gathered by means of a kind of snow plough, brought to the separating machine, taken thence to the drying oven and the press, whence it issues in the shape of smooth, shiny, dark brown bricks. A machine in operation at one of the chief peat works in Germany produces, provided suitable material is used, from 10,000 to 15,000 bricks in ten hours. Another machine, requiring six horse-power to work it, can produce from 60,000 to 100,000 bricks a day. In Germany the relative cost of peat as compared with hard coal is as follows:—One hundred kilogrammes (kilogramme = 2·2 lbs.) of good Zivickau hard coal cost at the mine 1·20 to 1·62 marks (mark = 1s.), while the cost of production of the same quantity of peat amounts to from 0·30 to 1·40 marks, according to quality. Besides its use as fuel, peat is turned into account in Germany as a fertiliser and as building material, it being successfully used as a filter for vacant spaces, separating layers for waterworks,

reservoirs, ice houses, &c. By means of a process patented by a tanner in Mayence, it has also been made to do service in tanneries. The waste or superfluous particles of peat, known as peat dust, have recently been brought into extensive use as a material for fitting up and preserving odourless vaults, an innovation, says Consul Stern, deserving strong commendation, especially in localities where the sewerage is inadequate. Hanover and Mecklenburg alone have from 140 to 150 square miles, and Bavaria has 22 square miles of peat moors.

THE MARBLE DEPOSITS OF COLOMBIA.

The *Bulletin* of the Bureau of the South American Republics says that resting on the granitic and basaltic rocks that form the geological plains upon which the more recent formations are stratified, and protruding through the coal measures, and separating the same for a distance of 10 miles between the San Juan and Rio Frio, are found the great marble deposits of the Atlantic coast of Colombia. The stone is in a great mass, covering about 60 square miles, and rising in bluffs 1,000 feet high from the sea level into the mountains of the Sierra Nevada de Santa Marta. The layers of marble are from 3 to 40 feet thick; the beds are uniform and even, and the separating seams contain enough decomposed calcium to make the quarrying of dimension stone practical and easy. The marble itself is a beautiful crystalline metamorphic limestone, resembling in colour, texture, and chemical ingredients the celebrated statuary marbles of Carrara in Italy. The crystals are of the most perfect cubes and others common to the calcium group, and the hardness of the stone is a little above the standard average of the Italian marble. In colour the stone is white, grey, black, white with black or blue veins, grey with black or white veins, white with pink veins, &c. The marble is susceptible of the highest polish, and free from injurious substances. From an industrial point of view, the Colombian marble holds an enviable position, from the fact that the deposit is situated nearly at the centre of the American continent, is only one mile from the Caribbean Sea, and a few miles from the Bay of Gaira, and but a day's sail from the Panama railroad, over which routes shipments could be made to the Pacific coast of the United States and South America. The stone exists in unlimited quantities, and is by far the largest deposit yet discovered on the American continent; of its class, it is said to be one of the best deposits so far reported from any quarter of the globe. Its great value is in the proximity of the stone to the ocean, and the facility with which it can be transported to other sections of the American coast at reduced rates. As no marble quarry is at present being regularly operated in any of the South American countries, the Colombian deposit has before it, if properly developed, the possibilities of a

monopoly. The Santa Marta railroad passes within half a mile from the marble deposits of the Cienaga, and the City of San Juan de la Cienaga lies on the shores of the Caribbean Sea, only a mile north of the Marble Mountain. It is stated that if placed in proper hands, and under an intelligent management, the property might be made to develop a profitable industry, and add to the progress of Colombia and the advancement of her material resources.

THE CULTIVATION AND PREPARATION OF MUSCATEL GRAPES.

Mr. Carl Luffmann, a well-known Australian agricultural expert, who has recently been studying viticulture and fruit-growing in Spain, says that the muscatel grape requires a ferruginous soil to produce the most fleshy and sweet fruit with the flavour of muscatel well marked. The vine also does well in slatey and stony ground, but grows most vigorously in deep alluvial soils, though in this last the fruit is deficient in flavour and bouquet, and is not well suited for drying purposes, as it is watery and lacking in gelatinous substance, but is excellent as a table grape, as it is luscious and very tender. The method of cultivation in Malaga is in every way simple and ordinary. The only feature there which is not observed in other grape countries is that the "crowns" of the vines are kept very close to the ground. The object of this is to enable the surface growth to benefit from the close proximity to all moisture rising from or descending upon the soil, and to prevent exposure to strong and harmful winds. The present crops are being drawn entirely from the new hybrid varieties which are grafted on the American phylloxera proof vine, "*Riparia*." Prunings of this vine are encouraged to root, and then grafted in a nursery bed, or planted out as cuttings, and the following year grafted as they stand in the vineyard. No special or particularly advantageous method of grafting is observed, and the system of pruning and tilling the soil is such as is well-known and practised in Australia. The Spaniards never encourage the growth of other crops between the vines, as the muscatel requiring good colour, flavour, and bouquet, it is absolutely necessary that the ground be given up to it. Where strong winds are frequent, an occasional row or belt of olive or similar evergreen trees may be used to advantage. Long experience has proved that land lying at a slope of from 30 to 45 degrees is the most favourable for the growth of raisin and wine-producing grapes. In Spain a south-east, and in Australia a north-east, aspect is best suited to the muscatel, as it requires the heat rays of the late-autumn sun. The vines yield a return in the second and third years, but are not expected to yield a paying crop until the fourth year. Green pruning is infrequent, as the fruit requires protection against the hot sun

and air in rapid motion. Muscatel grapes are never cut from the vine till the growth has practically ceased, for should grapes be cut whilst the sap is rising they would be insufficiently "primed," fermentation will take place, and the fruit rendered useless. The grower takes care to observe that the main stem of each bunch is brown and shrunken, and that the grapes on being pricked give off no free juice. The juice should be fairly set ere the grape is detached from the vine. The bloom of the grape is a most important item, and especial care is always necessary to develop and preserve it. Grapes far above the ground and exposed to air in motion, cannot get that perfection of colour which those possess when well sheltered and near the ground. Before the juice is set in the grape, the bloom is very free, but the juice congealed, the bloom becomes firmer, and will bear carefully handling, though the muscatel should never be handled, except by the stems, and always by naturally dry, cool hands. The method of drying and packing the grape in Malaga is as follows:—The fruit is cut, and brought in baskets to the drying slope, a pyramid-shaped mound of earth, held in position by brick or stone work. The surface of this mound is usually at an angular slope of 45 degrees, and is covered with loose, clean gravel. The fruit is placed over the surface of the slopes, and usually receives a turning over every other day for eight days, which is the usual time for drying, but exceptional heat or damp weather may reduce or advance the period considerably. A canvas awning is spread over the fruit during the night time, and also in the middle of very hot days. Uniformity of the day temperature is generally aimed at, and regular care in the handling and turning of the grapes. When the fruit is sufficiently dry, it will be shown by the fruit being passive. It can be pressed into any shape, and does not re-form itself. The seeds are also independent of the flesh, and should be an even coffee-brown colour, showing no trace of green at the small end. When the fruit is ready to be placed in the boxes, each bunch is examined, and, with the aid of a pair of scissors, all faulty and inferior grapes are nipped from the bunch. They are then laid aside to form classes, from 1 to 6, great care and equality of sample being observed in all samples. Without further treatment of any kind, the fruit is placed in well-dried boxes, the best fruits in thin layers between good white paper, and each layer is set off by a covering of single raisins of the best shape and appearance. Classes 3 to 6 are packed in a body, but with equal attention to boxes and paper lining. Fruit so prepared is exported to all parts of the world, and is considered able to retain its prime quality for three years, in almost any climate.

THE SHANTUNG SILK INDUSTRY.

The United States Consul at Peking, in his last report, says that a very important industry of the

Chinese province of Shantung is the rearing of silk-worms and the manufacture of silk. The silk is divided into two kinds, the produce respectively of the worm fed on oak leaves and that fed on mulberry leaves. The oak leaf silk is by far the most important to the provinces, although it is of an inferior quality, as owing to the comparative ease with which the worm is reared it is produced in great quantities. The cocoon is kept in the house during the winter, the moth appearing when warm weather comes. By the time the worm is hatched the oak leaves are generally out, and it is at once transferred to the trees, when beyond slight protection from birds it practically needs no further care until the cocoons are ready. Should the oak leaves be backward, pending their appearance the worm is fed indoors on other leaves. The trees must be at least eight years old for the worms to produce good silk. The cocoons collected from an acre of healthy trees yield from three to four catties of silk (catty equal 1.33 lbs. avoirdupois). The first crop of cocoons is generally allowed to hatch for the production of an autumn crop, the latter silk being better in colour and stronger. The silk pale brown in colour is reeled and woven by hand, the usual size of the pieces being about twenty yards by twenty inches; a piece weighs two catties more or less, according to quality, the exact weight being recorded on the edge. In the production of mulberry leaf silk, the worm has to be kept in the house and mulberry leaves provided for it daily. The mulberry trees are sometimes planted in fields, an acre supporting from ten to twenty according to the soil, but the more frequent position for them is on the edge of terraces, the corners of yards, or any spot which cannot otherwise be used. The tree should be ten years old for the worms to produce good silk, and such a tree should yield twenty to thirty catties of leaves a year. Twenty catties of leaves produce one catty of cocoons which yield about one-tenth of a catty of silk, the quality varying according to the richness of the leaves. The common practice in Shantung is to plant mulberry seedlings in masses, in the corners of fields, and to repeatedly cut them down; by this means a large number of young shoots are produced, which bud early in the spring, and these tender leaves are used to feed the young worms when first hatched, the leaves on the large trees being ready for them when they are older. There is a considerable demand on European markets for Shantung silk, and of late years the material manufactured for these markets has greatly improved in both reeled and woven silk. The great improvement in the reeled state is that the hanks are less than one-half the circumference they were ten years ago, which is a matter of importance, as according to the size of the hanks the framework from which it is woven must be larger or smaller; consequently the long hanks are often refused in the European markets, as they require too great a space in the factory. During the last two or three years some workers in Shantung have taken great pains in reeling to keep

the silk clean and of an even thickness, while they have contrived to introduce a twist in it. The silk has commanded a far better price than the ordinary article, and will probably increase yearly, especially as silk of any quality commands far more per picul (picul equal 133½ pounds) if sold in large lots than in small parcels, for in the foreign factories each alteration in quality necessitates a new arrangement of the machinery. The weaving of the silk for foreign consumption has lately improved, any width that may be in demand being now undertaken, instead of the former uniform width of twenty inches. Wide pieces command a better price per catty according to the width. Little improvement has taken place in the dyeing, and only inferior qualities or spoilt pieces are dyed, as the different threads take the dye in varying shades. Of late the demand from abroad for the commoner pongees has been far in excess of the supply, the smallness of which is possibly accounted for by the fact that coarse pongees are worn a great deal by the Chinese middle-classes, as they cost little more than imported cottons and are far more durable while they wash equally well; in fact all Shantung pongees are washed before coming into the market, being made very dirty in weaving. In all qualities of the woven articles it is calculated that the raw material represents about half the value of the piece, labour and transport making up the balance. The yellow silk, though yielding a much better price, is not produced to anything like the same extent, as it entails much greater labour.

FOREST TREES OF NICARAGUA.

In the luxuriant forests that cover so many square miles of territory, Nicaragua possesses an element of incalculable wealth, which, from its accessibility to the great markets of the world, will, it is anticipated, become the foundation of a great industry. According to a recent report of the Bureau of the American Republics, the mahogany (*caoba*) is the monarch tree of Central America, and is abundant in Nicaragua, growing to an enormous size, frequently measuring from 40 to 50 feet in height below the first branches, and from 9 to 12 feet in diameter at the base. At a short distance, the tree is a magnificent object, its giant arms stretching outward over a wide space, and surmounted by a great dome of verdure, which, at certain seasons of the year, is coloured with hues like the autumnal foliage of the trees in North America. This change of colour is the guide of the mahogany hunter, whose business it is find the trees in the dense forest, and point them out to the wood-cutters. The hunter climbs the highest tree he can find, detects the spot where they are growing, cuts a way to them through the undergrowth, and carves on the trunk his employer's mark. This magnificent wood has long been appreciated for its beauty by cabinet-makers and for decorative work; but its value for shipbuilding and other similar purposes,

has, it is asserted, never been estimated as high as it deserves. It is said to be in all respects superior to oak: it shrinks less, warps and twists less, is more buoyant, and weighs less. The tree is generally felled in the dry season, between October and May. When the tree is down, the branches are lopped off and the logs squared. They are then drawn by oxen to the nearest water-course, where they are rafted and allowed to remain until the high water of June or July, when they are floated to the port of shipment. The tree second only to mahogany in beauty and value is the cedar. In Nicaragua this tree is abundant, grows to an immense size, and produces wood of the finest quality. The wild cotton tree is one of the grandest forest trees. It grows rapidly and to great size; trunks of 70 feet in length and 14 feet in diameter near the root are not uncommon. The wood is useful for building purposes; it is higher than pine, but not quite so durable, and can be worked very easily. It is largely used by the natives to make canoes, many of them of large size, which are hollowed out from a single log. It is also used for making barrels. The tree produces large pods filled with a downy substance like floss silk; the shortness of the fibre renders it useless for textile purposes, but it is frequently used for stuffing cushions, pillows, &c. The *guanacaste* is a noble tree, renowned for its great size, and the enormous spread of its branches. It produces fine durable timber, and large quantities of gum exude from it, which might be made available as an article of commerce. The *jenisero*, a tree of the acacia family, also reaches large proportions, and produces an excellent wood, which is unknown to commerce, but which occupies a middle place between mahogany and cedar, with some of the good qualities of both. The *guayacan*, or *lignum vitæ*, is too well known to need description. There are two varieties of this tree in Nicaragua, black and green, and both are abundant in the forests. The *granadillo*, *rouron*, and *nambaro* (rosewood) are all beautiful and valuable cabinet woods, which grow abundantly. The *nispero*, which produces one of the best tropical fruits, also furnishes a most valuable wood which, for cabinet uses, rivals mahogany in beauty. The *madrono* produces a very fine-grained wood, suitable for turning, and is useful as a substitute for boxwood for wood-engraving and other purposes. The tree called *madre de cacao* (mother of cacao), which is used extensively to shade the cacao plants does not grow to a large size, but produces a wood called by the natives *madera negra* (black wood), which is useful for foundation posts, &c., as it is almost indestructible when underground. The *guapinol* produces a fruit from which an edible substance is made, and a gum equal in every respect to copal. Its wood is also very beautiful, and useful either for construction or cabinet purposes. The *cortés* is a large tree which produces a beautiful fine-grained wood of a pale yellow colour. It is very hard and could be made available for many industrial purposes. The *zapotillo*

produces wood which is the only kind known that will resist the attacks of the teredo, or boring sea-worm, so destructive in the Gulf of Mexico and the Caribbean Sea. There are also numbers of trees such as the *guachipilin*, the *guiliguiste*, the *palo de carbon*, the *coyote*, and the *chiquirin*, which produce woods excellent for underground use, and especially valuable for railway ties or sleepers. Oaks of several varieties, and particularly the live oak, which grows to an enormous size, and the long-leaved pine, called by the natives *jocote*, grow abundantly in the more elevated regions. The latter are particularly rich in resinous juices, and could produce abundant harvests of turpentine and tar. Dyewoods also abound in the dense tropical forests. One of the most valuable of these is called *morán*. Brazilwood, a variety of which is called in the country "Nicaraguan wood" (*madera de Nicaragua*) is abundant, also sandal wood, *nance elegueme*, and many others that produce valuable tinctures and dyes well known to the natives, but which have no commercial nomenclature, and are unknown in the markets of the world, although they can be found everywhere in Nicaragua. The trees and plants producing vegetable oils exist in great variety and abundance, such as the *jolio*, the *marango*, the *cacaguate*, and the castor oil plant. Among the medicinal plants known to commerce Nicaragua produces sarsaparilla, ipecachuana, jalap, croton, hellebore, cundurango, belladonna, quassia, ginger, copaiva, aloes, vanilla, and a large number of others, the virtues of which are well known to the natives, although even the names of some are unknown outside the country.

Obituary.

C. R. ALDER WRIGHT, D.Sc., F.R.S.—Dr. Charles R. Alder Wright, the eminent chemist, who died rather suddenly on Wednesday, 25th of July, at the age of 49, had been a member of the Society of Arts for 20 years. On May 8, 1884, he read a paper before the Applied Chemistry and Physics Section of the Society on "Cupro-Ammonium Solutions and their use in Waterproofing Paper and Vegetable Tissues," and in May, 1885, he delivered a course of three Cantor lectures on the "Manufacture of Toilet Soaps." According to a notice in the *Chemical News*, he received, as a boy, a preliminary training as an engineer, which profession his father desired him to follow, but he soon turned to chemistry. His research work began in 1866 with a paper published in the *Journal of the Chemical Society* on the "Action of Light on Sensitive Photographic Papers." At this time he was a student at Owens' College, Manchester. On leaving this college he became chemist at the Weston Works

of the Runcorn Soap and Alkali Company, and in August, 1867, he described his experience of alkali works in a paper read before the Chemical Society. Dr. Wright became a private assistant in the laboratory of St. Thomas's Hospital, but three and twenty years ago he was appointed Lecturer on Chemistry at St. Mary's Hospital, Paddington, an office which he held until his death. In 1878 he published his work on "Metals, and their Industrial Applications." He was elected a fellow of the Royal Society in 1881, and communicated to that society papers on the Ternary Alloys in 1889 and 1892. But his most important scientific work consisted of his well-known researches on the *Vegeto-alkaloids*, communicated to the Chemical and Royal Societies. A list of Dr. Wright's works is given in the current number of the *Chemical News*.

General Notes.

SOUTH KENSINGTON MUSEUM.—The forty-first report of the Department of Science and Art has just been published. It contains a statement of the yearly attendances at the South Kensington Museum from the opening of the museum in 1857 to 1893. The total from June, 1857, is 31,805,642, and the number for 1893, 1,174,211. The number of readers attending the Science and Education Library in 1893 was 18,087. The number of readers in the Art Library in 1893 was 22,951.

INLAND NAVIGATION CONGRESS.—The sixth International Congress has just been held at the Hague. The first section of the Congress was devoted to the consideration of matters connected with the construction and maintenance of canals and navigable waterways; the second section with stoppages on waterways in winter from ice, and the best means of preventing them; the third section with tolls on navigable waterways; and the fourth section with tidal waterways and the relation which exists between the curves in channels, and the depth and width. It was decided that the meeting in 1896 should take place in Italy.

FOOTPATHS.—The *Builder* quotes the following reference to a new way of treating footpaths, from the annual report of Mr. Lovegrove, the borough surveyor of Richmond:—"A new method of treating gravelled paths was introduced in Kew-road, where the foot traffic renders it almost impossible to keep the stones down; a length of path opposite the Athletic Ground, and also across Kew-green, was simply brushed over with tar, and covered with sea-shell, the cost being about 2½d. per yard super., and in result a smooth, even path was obtained. Now that the Town Council have the maintenance of over two and a-half miles of river path, this would be the most economical and satisfactory way of dealing with the walk."

TOWER - BRIDGE.—Mr. J. Wolfe Barry, C.B., communicated to *The Times* a record of the traffic through and over the Tower-bridge between July 9 and 22, from which it appears that during this period 1,173,645 persons passed over the bridge, the largest numbers being on the two Sundays, viz., 147,380 on the 15th, and 156,405 on the 22nd July. The total number of vehicles was 61,257, and the total of vessels passing through was 329. The number of times the bascules were raised was 273. Mr. Barry says that it was estimated that the time the traffic would be stopped each time the bascules were raised would be 10 minutes; the average comes out as 8 minutes, and Mr. Barry thinks that this may be reduced by further experience.

MATCH MONOPOLY IN FRANCE.—The *Economiste Français*, according to the *Board of Trade Journal*, contains particulars of the results of the match monopoly of 1893, taken from the report of the general direction of State manufactures. There were manufactured 28,422,242,550 matches (27,006,377,050 of wood and 1,415,865,500 of wax) ready to be delivered for sale. The cost of manufacture was 3,394,270 francs, the average cost for manufacture was therefore 119.42 francs per million matches. The general cost price of the matches ready for sale comes to 194.59 francs per million matches, which are sold wholesale for about 900 francs. The regie expended last year 6,349,006 francs. It sold wholesale or into the warehouses 29,340,192,390 matches, corresponding to receipts aggregating 25,874,542 francs. The profit on the manufacture of matches was therefore 19,500,000 francs, to which should be added the increase in the capital of the regie, which gives a net profit of 20,072,456 francs.

TOTAL PRODUCTION OF GOLD AND SILVER.—Mr. R. T. Mallett, referring to M. Edmond Thérý's figures as to the production of gold and silver, see *ante*, p. 704, writes:—"These figures show, then, that the relative production was in volume, one cubic metre of gold to 34.8 cubic metres of silver; in weight, it was one ton of gold to 19.2 tons of silver, and in value it was 1 gold to 1.22 of silver. One cubic metre of gold was equal in value to 28.3 cubic metres of silver, and last, but most important of all, because of its relation to current controversies, the value of one ton of gold was equal to 15½ tons of silver, on an average, over the whole period. At present, 1 ton of gold is equal in value to 33 tons of silver; and if the total quantities produced since 1492 were stated at this valuation, it would appear that the gold was 72 per cent. more than the silver; and if the value of the silver were represented by an ordinate of 1,000 feet high—the height of the Eiffel Tower—that of the gold would be represented by an ordinate 1,720 feet high."

THE FRENCH SILK INDUSTRY.—According to the *Moniteur Officiel du Commerce*, the French Silk Machine-weaving Syndicate has published some

interesting statistics of the working of the French machine loom industry. This working includes no less than 25,008 looms divided among 209 mills, distributed among ten departments—Ain, Ardèche, Drôme, Isère, Loire, Puy-de-Dôme, Rhone, Saône-et-Loire, Savoie, and Haute Savoie. The department of the Isère, which abounds in waterfalls, has alone 73 mills and 12,438 looms; the department of the Rhone comes second with 51 mills and 3,778 looms. One-hundred-and-forty-one mills and 15,041 looms belong to contractors who work for the Lyons manufacturers. Sixty-eight mills and 9,967 looms are the property of the manufacturers themselves. This method of direct and personal working, which is still the exception, is gaining ground each year, and in this manner there is being accomplished the transformation of an industry which, only twenty years ago, was carried on at home in small workshops, both in the towns and country districts. The number of hand-weavers, which was from 50,000 to 60,000 at Lyons under the Restoration, scarcely reaches 10,000 at the present time; and, further, the weavers find little to do, as they are unable to stand against the progress of machine weaving.

THE LIBRARY.

The following books have been added to the Library since the last announcement:—

Ansted, A.—*The Riviera: Etchings and Vignettes with Notes.* (London: Seeley and Co., 1894.) Presented by the Author.

Barnes, C. L., M.A.—*Sound: an Elementary Treatise.* (London: James Nisbet and Co., 1893.) Presented by the Publishers.

Blaine, Robert G., *Elementary Lessons with Numerical Examples in Practical Mechanics and Machine Design.* (London: Cassell and Co., 1893.) Presented by the Author.

Boyd, R. Nelson.—*Coal Pits and Pitmen: a short History of the Coal Trade and the Legislations affecting it.* (London: Whittaker and Co., 1892.) Presented by the Author.

Charlton, A. T.—*The choice of Coarse and Fine-crushing Machinery and Processes of Ore Treatment.* Seven papers read before the North of England Institute of Mining and Mechanics' Engineers. (London: A. Reid, Sons, and Co., 1892-4.) Presented by the Author.

Delano, W. H.—*Twenty-five Years' Practical Experience of Natural Asphalt and Mineral Bitumen.* (London: E. and F. N. Spon, 1893.) Presented by the Author.

Frankland, Percy, Ph.D., F.R.S., and Mrs. Percy Frankland.—*Micro-Organisms in Water.* (London: Longmans, Green, and Co., 1894.) Presented by the Publishers.

Frost, Robert, B.Sc.—*A Treatise on the Law and Practice relating to Letters Patent for Inventions.*

(London: Stevens and Haynes, 1891.) Presented by the Author.

Greenwood, Captain W. Nelson.—*Kludonometric Tide Tables and Port Directory for 1894.* (Lancaster: W. N. Greenwood.) Presented by the Author.

Gunn, E. S.—*Business Training Manual.* (London: Simpkin, Marshall, and Co., 1893.) Presented by the Author.

Howell, E. J.—*Mexico: its Progress and Commercial Possibilities.* (London: Whittingham and Co., 1892.) Presented by the Author.

Imperial Institute Series: *Guides to Commercial Collections (Indian Section).*—No. 1, *Guide to Collections of 1892; Handbooks of Commercial Products (Indian Section), Nos. 1 to 16 and 18 to 21.* (Calcutta: 1892-3.) Presented by the Imperial Institute.

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Journal of the Society of Arts.

No. 2,178. VOL. XLII.

FRIDAY, AUGUST 17, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS, 1895.

The dates fixed for the Society's Examinations in 1895 are—Monday, March 25th, Tuesday, 26th, Wednesday, 27th, and Thursday, 28th. The last day for receiving applications is Wednesday, the 6th March.

The arrangements of the time table, the subjects, and the prizes offered, correspond with those of the last Examination.

A Practical Examination in Vocal and Instrumental Music will be held in June, in London only, and the dates will be duly advertised.

Copies of the Programme, with full details, and an Appendix containing last year's questions and reports by the Examiners, can be had, price 3d., post free, on application to the Secretary, Sir Henry Trueman Wood, Society of Arts, Adelphi, London, W.C.

PRIZE FOR DESIGN FOR A SILVER CUP.

The Council of the Society are prepared to award a prize of £25 for the best design for a silver cup. The design, if adopted, will be used for the Swiney prize, which, under the will of the late Dr. Swiney, is awarded every five years by the Society for "The best published work on Jurisprudence." The value of the cup is £100. The offer is open to all students of schools of art in the United Kingdom. Competing designs should be sent in not later than the 31st December, 1894, addressed to The Secretary, Society of Arts, Adelphi, London. They may be sent in under a motto, or in the competitor's name, as preferred. Any design for which the prize of £25

may be awarded will become the property of the Society, to be used as the Council of the Society may direct. The Council reserves the right of withholding the prize, or of awarding a smaller amount, if it should see fit.

Miscellaneous.

SOME REMINISCENCES OF STEAM LOCOMOTION ON COMMON ROADS.*

I do not propose, in this paper, to give the whole history of steam locomotion on common roads, beginning with Cugnot's carriage—which, it is reported, really did move in Paris at some three miles an hour, as long as the steam kept up—as far back as 1769, nor to mention the propositions of the ingenious American, Oliver Evans, in 1772, whose plans, so far as regards common road carriages, it appears, were never carried out; nor do I propose, in this paper, to occupy any time about steam traction engines or road rollers, nor about steam motors on tramways; but I mean to confine myself to a description of some of the steam coaches, which carried passengers generally on the same carriage as that on which the engine and boilers were mounted—a construction which, so far as I am about to deal with the subject, it will be found was departed from only in the case of Sir Charles Dance's engine, hereinafter mentioned.

As indicated by the title of my paper, I intend to confine myself to some reminiscences on this subject, embraced, so far as my own knowledge goes, between, say, six or seven years in the 30's or 40's of this century.

I think I am right in saying that by about 1825 our turnpike roads, and the stage coaches which ran upon them, had attained to the highest degree of excellence. At this time, passenger railways were practically "in the air," omnibuses were running in London, and cabs were superseding the old hackney coaches; and there was a general feeling that on our magnificent turnpike roads, increase of speed and economy could be attained by the employment of the steam-engine, and it was also felt that such a mode of propulsion would compete successfully with the omnibuses. The natural result was that very many men, more or less ingenious, and more or less practical, devoted their attention to the subject of steam locomotion on common roads.

I propose to describe, briefly, some few among the whole number of those inventions which really resulted in carriages that did practical running on common roads. Certainly the most enduring and successful of these men was Walter Hancock. He took

* Extracts from a paper read by Sir Frederick Bramwell, Bart., before Section G of the British Association, Thursday, 9th August, 1894.

great notice of me, then an apprentice, and, after his day's run in London, frequently took me down on the coach to his factory at Stratford. I became very much interested in this subject, and took occasion to see all that there was to be seen, and to hear all that there was to be heard.

Another coach that did good service was that of Summers and Ogle. Summers was son-in-law to the engineer, Hague, to whom I was apprenticed. I was thus, as it were, in a steam-locomotion-on-common-roads-atmosphere.

In 1830, as you all know, the Manchester and Liverpool Railway, which I think I may fairly call the first real passenger railway, was put to work. Nevertheless, in 1831, a Parliamentary Committee of the House of Commons was constituted, which Committee reported in 1832, and I think it only fair to the enterprise of steam carriages on common roads, to give the summary of their report. It is as follows:—

"1. That carriages can be propelled by steam on common roads at an average rate of 10 miles per hour.

"2. That at this rate they have conveyed upwards of 14 passengers.

"3. That their weight, including engine, fuel, water, and attendants may be under three tons.

"4. That they can ascend and descend hills of considerable inclination with facility and safety.

"5. That they are perfectly safe for passengers.

"6. That they are not (or need not be if properly constructed) nuisances to the public.

"7. That they will become aspeedier and cheaper mode of conveyance than carriages drawn by horses.

"8. That, as they admit of greater breadth of tire than other carriages, and as the roads are not acted on so injuriously as by the feet of horses in common draught, such carriages will cause less wear of roads than coaches drawn by horses.

"9. That rates of toll have been imposed on steam carriages which would prohibit their being used on several lines of road, were such charges permitted to remain unaltered."

But not only did the opponents of steam carriages on common roads oppose them by obtaining heavy tolls to be laid on, but they used actual physical obstruction, as appears by the following:—

In a letter of the 3rd February, 1832, from Sir Charles Dance to Mr. Gurney, it is stated that on the 22nd June, 1831, "It was reported to me by my engineer" (Mr. Stone), "that large heaps of stones were laid across the road about four miles from Gloucester, 18 inches deep!!! which the engine had passed over twice (in going to and returning from Cheltenham), with considerable difficulty, and that it was so unusual a mode of repairing a road (which was in excellent order and required no repairs), that it must be a serious obstruction to all descriptions of carriages."

Mr. Stone's letter of the 22nd June, 1831, accompanies Sir Charles Dance's letter. It is as follows:—

"Yesterday morning we found the road filled up with loose stones for a considerable way near the 4-mile stone. The carriage with difficulty went through them, and also returned through them again, without any mischief, but the third time the strain broke the axle between the throws. The horse coaches have been stopped in the stones. The clerk at the Branch Bank of England says that he came across by the mail this morning, and that it was also stopped. Mr. Todd, of Cheltenham, says he was obliged to get down from the coach he came to town by, and that the horses could not get it through. 'The Champion,' from London, a fine 4-horse coach, was brought up, and, in whipping to get through, broke the harness to pieces. Waggons are obliged to get extra horses, in fact, the proceedings are most unaccountable. It is some relief, however, to know that the steamer has gone through, where the horses have been brought up, and I hope soon to get the axle mended."

But I do not think that either excessive tolls or road obstructions were the real cause of the cessation of the steam carriage enterprise upon common roads. Year by year railways were increasing, and the public lost interest in the common road steam carriage, which was merely to develop a speed of some 15 miles an hour, which required a large expenditure of power for the weight moved; and they turned, and wisely turned, towards the iron way.

Among the six or seven names with which I am most familiar it is difficult to assign any definite order of sequence of invention, inasmuch as, in some cases, the same inventor took out patents at varying dates. Hancock had a patent in 1827; so had Gurney; Summers and Ogle in 1830; Church, in 1832; Macerone, 1833; Dance, 1833; and Hancock another patent as late as 1839.

Hancock, and most of those who worked on the subject, dealt very wisely in one most important respect with their carriages to be used on the common roads; that is to say, the vehicles themselves were very commonly like a large stage coach, or (as I shall have to say with respect to Hancock) were of the omnibus form, or deviated from this by the adoption of the *char-a-banc* construction.

With the exception of the driving wheels, there was no moving part of the machinery visible. There was no noise from the exhaust (in the best of them), nor any visible indication of fire or steam; that is to say, neither smoke, nor a white cloud. Their appearance, therefore, was not such as to be, of necessity, alarming to horses. No doubt it was true that, during, say, the first week of the running of a steamer upon a regular journey, such as the Bank to Paddington, horses would pay some attention to it, but at the end of a week the horses habitually using the road were absolutely indifferent, and, in fact, horses generally were very little disquieted.

But for years after Hancock, steam locomotion on common roads remained in abeyance, and when it was taken up again it was with the totally different

object of traction engines, travelling ploughing engines, and road rollers. These were carried out by some of the best of our mechanical engineers, and, as machines, were excellent, but with respect to the horse difficulty, were about as bad as they well could be. All the moving machinery was visible; there was the "barking" noise due to the steam blast; they occasionally emitted fire; and their general forms must have been an abhorrence to any horse possessed of the slightest particle of good taste. The result, as we know, has been legislation, confining the use of these vehicles to night, or if worked in the day, to be preceded by a man with a red flag and the various paraphernalia.

I will now give a few particulars of the steam carriages to which I have already alluded, and I will commence with that of Hancock.

In all cases, the passengers and the engine and boiler were carried on one and the same structure, except when, to show the power of the engine, an ordinary omnibus body was towed behind the steam carriage.

Whatever may have been the nature of Hancock's earlier experiments, he settled down into a construction of boiler consisting of a number of flat chambers placed side by side, with spaces for the ascent of the products of combustion in between the chambers containing the water.

The boiler was an equivalent for a water-tube boiler, in that (as in water-tube boilers) the fire was outside the water, and not inside. This boiler combined lightness, strength, and large heating surface.

Hancock's collection of chambers was placed a short distance above the fire, or in the last patent was placed not directly over the fire, but at the side. There was an external casing, which contained the boiler, the fire-chamber, and the ash-pan. This pan was closed, and the draught was excited by a fan driven off the main engine. The waste steam was blown into the ashpit, and passed up through the fire, with the result that, except upon a very damp morning, at first starting, there was not, as I have already said, any visibility of the waste steam, neither was there any sound. The safety-valve, also, when it blew off, delivered the escaping steam into a silencing box. The engines were of the inverted vertical type, working on to a crank shaft, carrying a pitched pulley for a chain. This pulley could be uncoupled from the shaft by a clutch, and then the engines could be worked to drive the fan to get up steam, or to feed the boiler.

I need hardly say this was long before the days of injectors, and was also long before any common use of donkey engines.

On the axle of the hind wheels was a corresponding pitched pulley, either of equal diameter with that on the crank-shaft, or, I am inclined to think, of somewhat greater diameter. The wheels were of wood, having very strong spokes, enclosed in a cast-iron nave, with covering plate. They were loose upon the ends of their shaft, and had, on the outsides of

the nave, two driving projectors. On the ends of the shaft were two drivers, which could be drawn out of gear with the wheels by screws. In ordinary running, both drivers were in gear, but it will be seen there was left a very large amount, probably 100 degrees or more, of that which may be called "back-lash." Supposing that, in steering through the streets, it became necessary to make a slight curve. The result was that the wheel on the inner side of the curve did the driving, while the wheel on the outer side over-ran the driver. It was thus possible to follow a sinuous track with great ease, so long as the curves were inconsiderable in length. When it became necessary to make a very sharp curve, as, for example, to turn the coach completely round in a very small yard, in Wenlock-place, City-road, provided with only a single entrance, the clutch of the inner wheel of the intended circle was drawn completely out of gear, leaving the turning to be done by the outer wheel. In this way, the coach was got round practically in its own length, the fore-carriage being competent to "lock" to such an extent as to put the centre of the circle but a small distance away from the inner wheel.

This elaborate preparation to accommodate the driving wheels to the conditions needed when making a curved track, would, in these days, be, of course, wholly unnecessary, on account of the employment of the "Jack-in-the-box" arrangement, to attain the desired end, and to do so in a much better way. "Jack-in-the-box" has long been employed in traction engines, and, indeed, in the exhibition of 1862, a passenger carriage, built by Messrs. Garrett and Marshall, of Leeds, for Mr. George Salt, of Saltaire, was fitted with this apparatus.

In the latest of Hancock's coaches, "the Automaton," provision was made for partially condensing the exhaust steam by passing it through condensers of somewhat the same construction as that of the boilers, and placed in the water tanks which were under the floor of the *char-a-banc*. I am under the impression, however, that these were never a success. In fact, Hancock thought of every detail tending to the efficient working of his coaches. For example, he met a considerable difficulty that arose from the clinking of the fire-bars by two methods.

The first was to put the bars into a sliding frame so arranged that while the clean bars were at work supporting the fire, the dirty bars were altogether outside the fire-casing, so that they could be cooled down, and then the clinker could be readily removed. When this had been accomplished, the outside set of bars were fit to be slid under the fire, while the bars which had been in use were, in their turn, brought to the outside.

An alternative plan was to make the fire-bars circular, lying in supports and having projecting ends, made to take a winch handle. In this way the bars could be turned in succession, breaking them away from the clinker, which was then readily removable.

Another, and a great precaution to prevent "priming," since then, no doubt, very largely used, was, I believe, Hancock's idea, namely, the taking away the steam from the boiler through a very restricted orifice. My recollection is, but I do not speak with perfect certainty, that the pair of 10-inch cylinders (or they might have been 12-inch) in the "Automaton" were supplied by an inch and a-quarter steam pipe. This pipe had a coil bend in its passage from the boiler to the engine to admit of any variation, owing to the straining of the framing between the boiler and the engines, and thus to obviate the chance of fracture of the pipe.

In these days, as I have said, injectors were not, and considerable difficulty had from time to time been experienced by the sticking up of the valves of the feed pumps. To guard against this, Hancock used two suction valves in succession, and two delivery valves in succession.

The steering was done by means of an ordinary fore-carriage fixed upon a central vertical pin, carrying a pitched chain wheel geared up to a wheel of the same kind, keyed on to a vertical steering spindle, on which was a hand wheel. It was found in the outset, especially when going over pavement, that the blows inflicted by the pavement on the fore-wheels were communicated to the arms of the steersman with a very distressing effect. This was entirely got over by the simple expedient of a foot-brake.

These coaches worked for a period extending over 12 years. They, or some of them, made long journeys with great success; but their most interesting use, as showing the ability of steam-driven coaches to cope with the needs of the traffic of a great city, of many road materials, and of gradients exceeding that of any hill on the road from London to Holyhead, was their lengthened employment for ordinary omnibus traffic between the Bank and Paddington, and, morning and evening, between the Bank and Stratford.

The journeys were made regularly from Paddington to the Bank, backwards and forwards, involving, on the homeward journey, the ascent of Pentonville-hill. Not only did his various carriages surmount this ascent, without difficulty, but, on more than one occasion did they accomplish it even when towing an ordinary omnibus full of passengers behind them.

The New-road and Pentonville-road were "macadam"; the City streets were then of granite pitching, and the Stratford-road was of gravel. Over the whole of these different formations the coaches worked perfectly. The weights of these coaches varied in working order from $3\frac{1}{2}$ tons to $4\frac{1}{2}$ tons.

I am aware that I have spent much time over Hancock, more than I can afford to any other of the steam coaches, but I think Hancock is entitled to this extent of notice, because he persevered more than any other person who devoted himself to the subject, because I believe he understood its practical working better, and because he attained a far greater measure of success.

The next carriage with which I will deal is that of Goldsworth Gurney. His was essentially a water-tube boiler, and consisted of two main tubes (cast iron, I believe they were) placed horizontally parallel, the one above the other. From the lower of these main tubes there issued a series of wrought iron tubes, slanting upwards for some distance, and then bending, continuing on, over and to the top main tube.

The carriage (or, rather, these carriages) made various experimental runs, with more or less success, notably one from London to Bath, and worked for a considerable time between Cheltenham and Gloucester, but was eventually abandoned. I never saw it running, nor did I ever see it together as a whole; my personal knowledge was confined to the boiler, and was of the character of that of the converted cannibal, who, being asked what he thought of the late bishop, said he knew he was a very nice man, for he had eaten a bit of him. The very first day of my apprenticeship was occupied in holding the chisel-rod for a labourer, who was cutting up the boiler into scrap.

The next carriage I will mention was that of Sir Charles Dance. This was a steam traction engine, and had no seats for passengers, but towed an omnibus behind it. The engine was built by Messrs. Maudslay and Field.


This boiler was a strictly water-tube boiler, and, in cross section, somewhat like a capital letter X. Smaller tubes started from horizontal tubes, at an angle of 45 degrees or thereabouts, interspaced so as to pass each other at the centre of the X, and going upwards until they reached the special arrangements by which the steam was separated from the water. The pipes continued upwards, and were united by cross tubes from which the steam was taken.

This carriage worked extremely well, and went at a very considerable pace; for instance, I remember travelling by it, from London to Reading—a distance of about 45 miles—which, on the down journey, was performed, from Hyde-park-corner, in $3\frac{1}{4}$ hours, towing a full omnibus behind it. I remember we put up in the inn-yard of a coaching-house—the name of which I have forgotten—but we had to select this yard because it had gates at each end, and, therefore, we could get out without having to turn round in the yard.

I presume Messrs. Maudslay simply followed directions; but however this may be, the driving-wheels of the traction engine were both of them keyed on the shaft hard and fast, as though they had been the paddle-wheels of a steamer, with the result that it was impossible to make a curve of a small radius, and I remember the right angle turn from the street into the inn yard was only made by a succession of backings and fillings, and my impression is that, even with these, we did not accomplish the right angle bend without sacrificing one of the gate-posts.

We left Reading, I think, about three o'clock in the afternoon; but the return journey was not done nearly so quickly.

The stoker, although he had dined, was fatigued, and he allowed the fire-bars to become clinkered. Most of the passengers, I being of the number, tired of sitting inside an omnibus (remember there were no garden seats in those days, nor even "knife-boards") came outside, and sat along the edge of the roof all round, like undertakers' men on a hearse. How we held on I don't remember, but we arrived at Hyde-park-corner in the height of the season, covered with soot and blacks that we had received from the funnel. I doubt whether this traction engine (for such it was) worked more than experimentally for one or two seasons.

Summers and Ogle's boiler was strictly a water-tube boiler. The tubes are vertical, and have each an internal tube, giving therefore an annular water space. The external vertical tubes are connected at their top and bottom in transverse tubes which, I believe, were of a  section, the lower ones to make the water connection, the upper ones to make the steam connection, while the internal tubes served as stays to join the vertical and horizontal tubes together.

This boiler was made of charcoal iron, was proved to 364 lbs. on the square inch, and ran at 240. The boiler weighed $8\frac{1}{2}$ cwt., and had 245 feet of heating surface, including the portion which was occupied by the steam. The iron was $\frac{1}{10}$ th of an inch thick.

This coach worked very successfully in a variety of long and short journeys, but, like all the rest, was eventually abandoned.

Macerone and Squire's boiler was, practically, Summers and Ogle's boiler; that is to say, vertical water-tubes, but with the internal tubes omitted, and with the side tubes longer than the tubes in the middle, so as to form a partial external wall to the fire-place.

Colonel Macerone was a powerful man with his pen, and those who are interested in the subject of steam locomotion, and are willing to take it from Colonel Macerone's point of view, are referred to a pamphlet, published by Effingham Wilson, Royal Exchange, and George Herbert, Cheapside, in 1835.

There is another pamphlet by Macerone, I believe, in the following year, called "*Macerone, versus The Mechanics' Magazine*," which may interest students of the subject.

This carriage ran very successfully, but I am obliged to close the account of it, as usual, by saying that it was eventually abandoned.

In the boiler of Church's coach the fire was made in a water-jacketed portion of the boiler, which at its higher end carried a vertical cylinder having a bottom tube plate through which rose a number of vertical tubes, which, at their top ends, as I remember was said at the time, turned over and outwards like the supports of the ribs of an umbrella, and thus were enabled to pierce the sides of the vertical boiler, and to obtain access for the products of combustion which had passed through them to a circular flue space surrounding the vertical part of the boiler.

My recollection is that this boiler, or modification of it, was put into a coach (or coaches) which actually ran, but I cannot find any particulars of the journeys.

There is a drawing of Griffith's carriage, which was constructed by Messrs. Bramah (for Mr. Griffith), on p. 241 of the 1st volume of Limberd's "*Mirror*," 15th February, 1823.

The carriage is stated to weigh $3\frac{1}{2}$ tons, and was destined to carry 3 tons of merchandise, but I have no account of its running.

The boiler consisted of two flat vertical water chambers, placed one on each side of the fire, and connected together by horizontal water tubes—2 feet long and $1\frac{1}{2}$ inches in diameter—of which there were 114. The boiler never could be kept tight, and the whole thing was a failure.

Scott Russell's is the last steam coach of which I intend to give any description.

As many as seven or eight were built, to run between Glasgow and Paisley. These coaches had been running some time when, on the 29th July, 1834, one of them exploded, as it was starting from the "*Half-way House*." Three persons were killed practically on the spot, and, I believe, two or three of the wounded died afterwards.

Mr. Scott Russell did not take out any patent for his boiler except in this sense, that he patented a cubical vessel, made of extremely thin flat sides, but strengthened by innumerable tie-rods, going from side to side. I believe he suggested one for each square inch. He shows no other drawing than this typical vessel, but says, in effect, it would be easy to apply his principle, when flues, &c., are introduced for the purpose of employing the vessel as a boiler.

I believe this construction was adopted in the coaches before mentioned.

After this explosion, two of the coaches were sent to London. I saw one of them under way. I believe I rode by it.

According to my recollection the steam pressure was much reduced, and the speed, I believe, hardly exceeded a walking pace. It is said that one of these boilers burst in Oxford-street, but I did not see it, nor did I know much about it. No one appears to have been injured.

The terrible accident at Glasgow had a very damaging effect upon the progress of steam carriages on common roads.

My last reminiscence of a passenger steam carriage on a common road is a comparatively recent one; I refer to the carriage constructed by that most able mechanic, the late Mr. Loftus Perkins. This was purely experimental; it carried only two or three persons. The boiler was the well-known "*Perkins*" water-tube boiler; the engines were compound, and with the boiler, were carried on the framing of the single steering wheel (it was a three-wheeled vehicle), which was also the driving wheel, so that the crank-shaft was always normal to the direction in which the carriage was going.

When speaking of Hancock, I gave him the credit for being the introducer of diminishing "priming," by the use of very small steam pipes. Perkins, with this high-pressure steam of some 600 lbs., carried this principle to a still greater extent, and he was in the habit of wearing on his watch-chain a piece of pipe having a bore of only $\frac{1}{8}$ inch, through which he had taken the steam for 40 horse-power.

I am informed, by a letter from Mr. Perkins' son, that this engine is still in use at Gypsum Works, near Battle.

I do not make any reference to Nairn's carriage, which ran for a long while between Edinburgh and Leith. I do not refer to this, because, although no doubt it is one of my reminiscences, it is one of so recent a date that it must be included among your reminiscences. Neither do I propose to enter into the description of the competition among the self-moving road vehicles in France which is now taking place, but I am glad to see—from the illustrations in the technical papers—that the French have appreciated the desirability, indeed, the need, of constructing the vehicles in a manner that should not shock the susceptibility of horses; and, as one who is, and always has been, much interested in this subject of steam locomotion on common roads, I am very glad to find that it has been taken up by our neighbours, who, having regard to their great engineering ability, and their consummate taste, should, of all people, be likely to obtain a successful result.

ACTION OF LIGHT ON DYES.

The following is a summary of the report of the committee on the action of light upon dyed colours, presented to the Chemical Section of the British Association:—

During the year a large number of wool and silk patterns, dyed with various natural and artificial orange and yellow colouring matters, had been examined with respect to their power of resisting the fading action of light. The patterns were exposed at Adel, near Leeds, in the grounds of Mr. James A. Hirst. Each dyed pattern was divided into six pieces, one of which was protected from the action of light, while the others were exposed for different periods of time. On silk, the relative fastness of the various colours was, for the most part, the same as on wool, the differences being unimportant. Orange and yellow patterns give a comparatively large number of satisfactorily permanent colours. In the more or less fugitive class were to be found all the basic colours, all the nitro-phenols, with the exception of palatine orange, and all the bright yellows derived from the natural colouring matters by means of aluminium and tin mordants, with the exception of those obtained from weld. Comparatively few azo colours were met with in this group. By far the largest number of yellows, ranging from "moderately fast" to "very

fast," were to be found among the azo colours. Specially important were those in which salicylic acid was a constituent element, since not only did this impart to the colour the power of forming more or less stable lakes with chromium and aluminium mordants, but it appeared frequently to give the colours the quality of fastness to light, even when no mordant was applied. The colours obtained with aluminium were practically as fast as those fixed with chromium, since the first-named mordant gave much brighter and purer yellows. The tin mordant, so useful in the production of the most brilliant orange and yellow colours obtainable from the natural colouring matters, seemed, however, to be of little or no advantage in connection with most of these azo-mordant colours, no doubt because they were susceptible to the reducing action of the mordant usually employed for wool, viz., stannous chloride. Very interesting in point of fastness to light were the azoxy colours, and although, unfortunately, apt to dye wool somewhat irregularly, giving speckled-looking colours, they were admirably adapted for silk and cotton. Another interesting little group was that which includes tartrazin, a colour, not only noteworthy for its fastness to light, but also because of its brilliancy and purity. The fastness of alizarin orange was worthy of special mention, for it was probably greater even than that exhibited by most other colours of the alizarin group, and it showed the peculiar darkening action exerted by the light, probably in consequence of the presence of the nitro group. It was remarkable how few really fast yellows were derived from the natural colouring matters, and these were chiefly the olive yellows obtained with chromium mordant. The only fast, and, at the same time, bright, natural yellows, were those derived from weld, and since the dye-stuff was now of little general importance to the dyer, its cultivation had become extremely limited, and was gradually being given up. It was fortunate, therefore, that science had been able to replace it by efficient substitutes, so far, at least, as permanency towards light was concerned. The experiments had already abundantly proved that the popular opinion that the coal-tar dye-stuffs included only such as yielded more or less fugitive colours, was entirely false; indeed, it was perfectly safe to assume that coal-tar was the source from which the greatest number of colours fast to light were derived at the present time, and this seemed to be specially true of the red and yellow colours.

FARM MANURE IN SOUTH INDIA.

The Department of Land Records and Agriculture of Madras have issued the following information on the care and management of farm manure in South India, by Mr. C. Benson, Deputy Director:—

Unfortunately the amount of manure which the ryot finds at his disposal is usually but small. It is

also of but poor quality. Owing to want of proper care of the supplies available, and to bad management, the stores of manure are generally small. Similar reasons explain the low quality of the manure.

In some places where wood fuel is scarce, and near large towns, a very large proportion of the cattle dung is made into cakes, and used for fuel, only a little ashes remaining for use as manure, and even these, in cases where the cakes are sold into the towns, being lost to the ryot. When his cattle dung is burnt by the ryot himself, the ashes are generally thrown into a heap into the open, where they become leached of much of their valuable matters. That the practice of burning cattle dung is a cause of great loss is known to every one. By using the dung of his cattle for fuel, the ryot makes only a very petty saving in expenditure, whilst he could, by growing fences round his fields, as is done in parts of Coimbatore and Salem, or by setting apart a small portion of his fields on which to grow trees for fuel, easily provide himself with fuel sufficient for his wants. By such means the very wasteful practice of burning cattle dung may be avoided. Near large towns the price of fuel is so high as to render the growth of fuel trees generally a profitable undertaking.

The more general practice of the ryot is, however, to accumulate the dung of his cattle in a loose heap in the open air. The dung there dries into hard lumps, and is thoroughly washed by any rain that falls. It suffers loss in every possible way, and the ultimate result is a small heap of very poor, almost valueless stuff left, to be carted to the fields. With the dung is to be seen a certain amount of straw and leaves. Each material is left to itself, the dung to lose its value, the stalks to become hard and desiccated. Because in India no litter is supplied to the cattle, not once in a thousand times is any attempt made to save the urine of the cattle when they are kept in the houses or sheds of their owners. Wasteful this process is, because the solid manure is exposed as described. Still more wasteful and injurious is it, because the manure is not only not preserved, but is allowed to sink into the ground, and especially into the hollows made by the feet of the cattle. The soil on which the cattle stand is saturated below by the urine, and the air of the house or shed becomes foul and contaminated. Every one has noticed the strong and peculiar odour found in these sheds in the morning. This is due mainly to the evaporation of valuable matters contained in the urine which drops on the floor and is lost.

The value of the urine of his cattle as manure is not, it is to be feared, appreciated fully by the ryot, even if the value thereof is not totally unknown. The urine, as a matter of fact, is richer in fertilising matters than the solid excreta of cattle, and the loss involved in letting the urine go to waste is very large. This loss may be avoided by the use of litter to absorb the urine, or even by sprinkling the floors of

the cattle-sheds with dry earth, if litter be unprocurable. By the latter process, much of the urine could be saved, the earth being allowed to accumulate in the sheds till required for use as manure, or being removed as it becomes saturated, and carefully preserved in a manure pit as is described below. In cases where cattle are tethered or penned in the fields, the urine soaking into the land is not lost.

If the ryot be asked why he does not use litter for his stock, he usually says that he has not enough fodder to feed them properly, still less has he straw for use as litter. The appearance of so much waste straw, &c., in the manure heaps is, however, often evidence that this is not the reason, for these matters, as well as coarse grass, weeds, leaves, and rubbish of all sorts, might be used as litter, and the quantity required, especially if dry earth be also sprinkled over the floors, is not large.

As has already been said, the most valuable portion of farm manure consists of the urine of the cattle. The manure comprises also, when properly made, the whole of the solid dung as well as the litter used for bedding the cattle. As it consists of litter and the voidings of animals fed on the produce of the soil, it forms in itself a complete fertiliser. In the making of good manure, it is of importance that all these matters should be thoroughly and intimately mixed, and that they should be preserved carefully after they have been collected, so that the whole mass may ferment and decompose slowly and thoroughly. The value of farm manure lies probably as much in the mechanical effect it has on the soil to which it is applied as on the fertilising matter it contains. The mechanical effect depends greatly, if not chiefly, on the state of decomposition in which the manure is when applied to the land.

An excellent method of managing farm manure, suited to the conditions of the ryot, is described below. In this method the dung and urine are not removed from the shed except at intervals of seven months, when the manure is required. The litter used absorbs the urine.

The floor of the cattle-shed should be made two or three feet lower than the surrounding ground, and the sides and the bottom of the pit plastered with clay. On the floor a layer of ashes should then be spread once for all, and every day a layer of vegetable rubbish should be spread over the surface as litter, that is, for bedding. For this purpose, leaves, coarse grass, and other vegetable rubbish, may be collected and stored during those parts of the year when they can be easily procured, and when the ryot and his cattle have plenty of leisure. Waste fodder and various refuse portions of crops, such as ear-heads from which corn has been thrashed, &c., may be used as bedding. The shed may be ten feet long and six broad for a pair of cattle. It is best that the cattle should be left loose in the shed, so that they may tread on every part of the manure and press it down. If the manure is not pressed, it will rot too fast, and

become much heated and give off bad smells, and the health of the cattle will be injured. Every morning the dung dropped by the cattle in the previous night should be evenly distributed, and a thin layer of litter spread over it. In this manner the manure may be collected until the pit is filled, which may take about three months.

Too much bedding should not be supplied, otherwise the manure will be too dry and not decompose with sufficient slowness, and thus lose in value. The manure in the pit should always be thoroughly moist throughout its bulk. If the manure has an ash-coloured appearance anywhere when it is being removed, that is a sign that it is not decayed properly, this appearance being due to the great heat caused by the manure being too dry. If the straw, &c., supplied as bedding be long and hard, the manure will not rot properly; such litter should be cut up into short pieces. Unless the manure is well rotted, it will not act quickly. It will also make the soil too open, so that the crops thereon may suffer much from drought. The manure, if properly managed, will be of a black colour and of mellow substance, thoroughly rotted throughout, so that it may almost be cut with a knife. In removing manure from the pit the unrotted portion near the surface should be placed on one side, and after the well-rotted portion has been taken out, should be put back again at the bottom of the pit, and manure may be collected again as before. By this method of managing manure, about five to seven tons of good manure may be obtained yearly for each head of cattle kept, whereas if the dung be thrown out in loose heaps in the open air, only about half a ton of very inferior manure will be obtained in the year.

The only objections raised to the system are (1) that it is supposed to cause unhealthiness amongst the cattle housed, (2) that it requires a large amount of litter to be supplied. In reference to the last, it may be noted that in some parts of South Canara the ryots take great pains to collect leaves and grass, and supply bedding to their cattle; but they remove the manure at intervals of a few days, and throw it out in a hollow place where it can be compressed by the carts travelling to and fro over it. In reference to the first objection, experience has shown that it is groundless.

If, for any reason, it is inconvenient to a ryot to collect manure in the above-mentioned manner, the following method may be adopted. The floor of the cattle-shed should be made smooth and compact, with a gentle slope towards the back, where a small channel should be placed so that all the urine falling on the floor may be carried by the channel to a pot placed outside the shed at one end. The dung can be removed every day and thrown into a pit, the sides and bottom of which should be plastered with clay, and over which a low thatched roof has been erected. Whatever vegetable refuse is available on the farm may be thrown into the pit, and the urine collected poured over the heap daily. The whole mass of

dung, urine, and vegetable rubbish should be kept uniformly mixed, and well trodden and pressed down, so as to make the mass decay uniformly and slowly.

If the manure pit last described cannot be protected by a simple shed, the heap should be covered with earth. It has in all cases been found very useful to cover manure heaps with earth, as this prevents the loss of valuable fertilising matters into the air. This practice is fully adopted in some places, *e.g.*, in Tinnevely, with the best results. If the upper portions of a manure heap become dry, the heap should be turned over so as to mix the moister and the drier portions together, and if there be any tendency for the heap to dry up generally, it may be watered slightly with advantage. The covering of the heaps with earth to a great extent prevents undue drying. The great aim should be to maintain the heap in a moist state, so that the whole mass may decay slowly and completely, and thus the fertilising matters of the manure may be preserved, and rendered more immediately useful than as they are found naturally.

FORESTRY.

At the Oxford meeting of the British Association, Professor Isaac Bayley Balfour, President of the Biological Section, drew special attention in his address to the condition of British forestry, and the need for a wider cultivation of timber. He said little attention has been paid in this country to forestry as a branch of applied science, although the beauty of an English landscape lies in its trees and pastures, and the country is especially well adapted for tree growing. Forests are useful to a country from two points of view—as a source of timber and fuel, and on account of their hygienic and climatic influences. Forests improve the drainage and exercise through the process of carbon assimilation a purifying effect upon the air. They increase the relative humidity of the air, and they protect and control the waterflow from the soil. Last year we imported into Great Britain more than £18,000,000 worth of timber, much of which might have been grown at home. And it is important that we should turn our attention to growing timber, for the supply in the great wood-producing countries, such as Sweden, Russia, and America, is giving out, though by the application of scientific principles timber sufficient to meet a greater demand than is now made could be produced. In Great Britain we have less than 4 per cent. of the total area under wood, whereas in Sweden the amount is over 40 per cent. Of our forests, Windsor is chiefly specimen trees, Dean results is an annual deficit, and the New Forest is being allowed by Parliament to go to rack and ruin. Forestry is handicapped by the fact that the return from woods is not immediate, but scientifically worked a forest area or suitable land, of which there is such abundance in Britain, should be

capable of yielding an annual net revenue as regular as that obtainable by any other form of soil cultivation. But the home wood grower has just cause for complaint when he finds his produce handicapped by preferential transport rates to foreign timber, and also boycotted by architects and even by the Government. As the wood is excellent these difficulties would probably disappear if a more regular and certain supply could be depended upon. In Scotland timber has been grown at a profit, and the provision of work in the country in saw mills and other industrial works is a powerful aid in restraining migration to the towns. To become a profitable industry forestry must be practised as an applied science, and not as an empirical routine. The Government should treat its forests reasonably and scientifically, and make them models of the best forestry practice. Centres of instruction should also be established, but beyond this the State ownership of forests does not seem to be necessary in the cause of forestry. The true solution of the forestry question in Britain is to be found in the diffusion of accurate knowledge of forest science, and it is through education alone that we can arrive at improved forestry. Some good books, chiefly written by foreigners, are being issued, and Cooper's-hill is now excellently equipped for teaching. The subject should be taken up by County Councils, but if schools were founded it would be difficult to find teachers. Botanists must lay the foundation of forestry, and so mould the studies of pupils that they are put in the right way, and if we only had a few men so trained as competent foresters by Continental schools scientific arboriculture would soon become a fact in Britain. The botanists must be the apostles of forestry.

SPRING SPOKES FOR BICYCLES.*

By PROF. J. D. EVERETT, F.R.S.

The author described a construction of spring-spoked wheels for bicycles, in which both lateral and rotational yielding are so moderate in amount as to occasion no inconvenience. Each spoke consists essentially of a small coil spring, weighing half an ounce, attached to a light spoke wire, the connections of the ends of the spoke to hub and rim, as well as the connection between spring and wire, being of the hook-and-eye kind. The attachment to the rim is made, not at the centre of the rim, but at its edges, semicircular notches being cut, into which the spokes are hooked, and the spokes attached to either edge of the rim are attached to the opposite flange of the hub, so as to cross the plane of the wheel. The spokes of the driving-wheel are not exactly radial, but slope a little backwards and forwards alternately, an arrangement which materially diminishes rotational yielding, while the crossing above described diminishes lateral yielding.

* Paper read before Section G of the British Association Meeting at Oxford.

It has generally been maintained that, while up-and-down elasticity is useful for relieving jolts, lateral and rotational yielding are evils to be avoided. The author differs from this view, and maintains that both lateral and rotational yielding, of the elastic kind, when kept within proper limits of magnitude, are beneficial, both as regards comfort and speed.

When one of the wheels of a bicycle encounters an obstacle (such as rough roads abound with), the collision produces an impulsive reaction on the wheel, as if the obstacle struck the wheel. Sometimes the direction of the blow lies in the plane of the wheel, but in many cases the wheel is not only checked and lifted, but at the same time driven to one side. In order to cushion the lateral component of the blow there must be lateral yielding. Accordingly, in running over patches of stones, which jerk the ground-point of a wheel from side to side, the usual jarring of the hands and disturbance of the steering are noticeably absent in bicycles with spring spokes.

As regards a blow delivered in the plane of the wheel, the impulse may be resolved into a radial and a tangential component. The radial component is cushioned by the shortening of spokes in the neighbourhood of the point of impact, and the lengthening of the diametrically opposite spokes.

The tangential component is equivalent to an equal and parallel impulse on the rim in a line passing through the centre, combined with a torque. The torque, from the symmetry of its action round the axle of the wheel, produces no jar; but the impulse in a line through the centre tends to drive the rim backwards and slightly downwards, with respect to the axle. It is cushioned by the elastic shortening and lengthening of spokes which are nearly horizontal.

This elastic yielding of a pneumatic tyre is mainly in the radial direction, and is practically *nil* in the tangential direction. Its lateral yielding is very much less than that afforded by spring spokes.

Next, as regards rotational yielding of the driving-wheel, the propelling force applied by the rider to the pedals is given out at the ground-point of the wheel in the shape of back-pressure of the wheel against the ground. The more rigid and unyielding the connection between these two parts of the mechanism is, the greater will be the tendency to jarring of the feet by inequalities of the ground. Even on smooth ground there is a jerk at the beginning of each stroke, in the case of an unyielding wheel, which tends to fatigue the knee. The difference between the energy given to the springs and the energy which they return is quite trifling in comparison with the saving of energy which results from the easing-off of concussions. Moreover, the energy stored in the springs is useful in carrying the wheel past the dead-points, a small pressure unconsciously exerted on the pedals being sufficient to retain the energy till it is wanted.

An indirect benefit from lateral yielding is the diminution of side-slip. Side-slip will begin as soon

as the lateral force called out between the wheel and the road at the ground-point exceeds a certain limiting amount. Lateral yielding eases off the suddenness of lateral impulses, thus keeping down the maximum amount of lateral force; and this is precisely what is required for preventing side-slip.

In some of the driving-wheels which the author has constructed the hub is allowed to project much farther on the side remote from the driving-chain than on the side next the chain, in order to permit the combination of a wide hub with a narrow width between the pedals. Weaker springs are used on the projecting side than on the other side. This unsymmetrical arrangement is not found to interfere with the ease of steering.

TAXATION OF INDUSTRY AND COMMERCE IN SPAIN.

The tax on industry and commerce in Spain has undergone many and various changes before assuming its present form. Sir George Bonham, Her Majesty's Secretary of Embassy at Madrid, says that when the seigniorial rights or ancient dues of the Crown proved insufficient to meet the expenditure of the State, more especially at the time of the wars with the Moors, the kings had recourse to the Cortes, which granted what was necessary to meet the requirements of the moment. This happened so frequently that these sums gradually took the form of a permanent tax, payable every three years, under the name of *Servicio Ordinario de Monedas*, and being levied on farms, commerce, industry, professions and arts, may be considered to be the origin of the tax. There were, of course, the usual exemptions in favour of the nobility, clergy, officers of the Royal household, the villages bordering on the Moorish possessions, the doctors of the universities, and newly-married people, for two years. The tax was collected by the *Procurador del Rei*, who received $1\frac{1}{2}$ per cent. as his share. It gave rise to many complaints by reason of its uncertainty and injustice, and was finally abolished, in 1795, by Charles IV. When the provincial rights of Aragon, Catalonia, Valencia, and Majorca were abolished by Philip V., and the tributary system of Castile was substituted, the tax was levied under the generic name of *equivalente*. In Majorca, however, it was named *talla*, and, in Catalonia, *catastro*. By a decree of Joseph Bonaparte, dated November, 1810, everyone carrying on any business, commerce, arts, or profession, was obliged to obtain a license or patent. A tax was attached to these patents, and also a small sum divided between the municipality and the secretary by whom they were issued. The tariff by which the tax was fixed was divided into two groups, one comprising the industries and professions paying the same amount in all the cities of the kingdom, the other, paying an amount varying according to the

class of town or its industry, to which a third was afterwards added, comprising shops for the sale of meat, fish, vegetables, &c., the sums payable being assigned under three heads, according to the importance of the locality. The classes of towns were five in number—(1) Madrid; (2) provincial capitals and seaports inhabited by foreigners; (3) leading provincial towns; (4) places of sufficient importance to have a mayor or judge; (5) the other villages of the kingdom. The classes of contributors were ten in number, each paying a separate quota corresponding to the description of township to which they belonged. In these ten classes were included all the industries, professions, &c. On the departure of the French, their decrees became null, but the principle was reintroduced, and the tax, with modifications, remained more or less in this form until 1847. By Royal Decree of September 3 in that year, direct taxation according to the system described was abolished, and the system of *agremiacion*, or associations, nearly corresponding to guilds in other countries, established. The duties were levied on the basis of population, upon industries and professions coming under tariff 1 of the previous system, and without reference to population on the classes comprised under tariffs 2 and 3. All those exercising the same trade or profession were to form a guild or association for the payment of the tax. The members of the guild were collectively responsible for the payment of the sum allotted to them, but could distribute it proportionally, at their own discretion, amongst the various categories of industries comprised in their association within certain fixed limits. Certain persons elected by members of the guild, with the approval of the Government, for the purpose, became individually responsible for the payment of the tax into the Treasury, and against them proceedings could be taken in case of default. Every one exercising a profession or calling without having obtained a certificate proving him to be enrolled as member of a guild, was liable to a fine of double the amount due, which could be executed by distress, unless within four days a person could be found belonging to a guild to give security for him. The tax, with certain changes in the classification of industries, has remained in force upon this basis up to the present day. Every Spanish subject or foreigner, carrying on any trade, profession, or business, is subject to it. It consists (1) of a fixed sum to be paid to the Treasury according to the tariff; (2) of the additional duties authorised by law in favour of provinces and municipalities, the maximum being 16 per cent.; (3) 6 per cent. on the foregoing sums, which is distributed as follows:—1 per cent. on the net sum paid into the Treasury, half of which goes to the Treasury for expenses of registration, and half to the local *alcaldes* and secretaries of municipalities employed in the work. For the collection of the tax a proportional per-centage is paid, according to the district, the remainder being applied to satisfy the expenditure necessary for de-

veloping and covering, as far as possible, the sums in default. Each year a register is drawn up, in duplicate, of the individuals subject to the tax in each village, divided according to tariffs, classes, numbers, and trades, showing the amount payable by each. Any attempt to defraud the State on the part of those liable to the tax, or those entrusted with its collection, is punishable by fine, which can be doubled in the case of a second offence; on the other hand, syndics and other officials are entitled to two-thirds of any fines they may be instrumental in getting imposed. The history of the tax on industry and commerce has now been traced through all its successive stages. The systems successively in force have all been directed to the establishment of a just proportion payable by individual contributors, but no attempt has been made to fix the sum payable by different industries. The quotas hitherto paid by them bear, however, no relation to their individual production.

SIGNALLING THROUGH SPACE.

Mr. W. H. Preece, C.B., F.R.S., read a paper before Section G, at the British Association Meeting at Oxford, on the subject which he treated in his paper, "Electric Signalling without Wires," before the Society of Arts on February 21st last (see *ante* p. 274). The general results and conclusions are thus stated:—The earth acts simply as a conductor, and *per se* it is a very poor conductor. On the other hand, the resistance of the "earth" between the two earth plates of a good circuit is practically nothing. Hence it follows that the mass of earth which forms the return portion of a circuit must be very great, for we know by Ohm's law that the resistance of a circuit increases with its specific resistance and length, and diminishes with its sectional area. Now, if the material forming the "earth" portion of the circuit were like the sea, homogeneous, the current-flow between the earth plates would follow innumerable but definite stream lines, which, if traced and plotted out, would form a hemispheroid. Now this hemispheroidal mass could be replaced electrically by a resultant conductor of a definite form and dimensions, and in considering the inductive action between two circuits having earth returns, it is necessary to estimate the position of this imaginary conductor. This was the object of the experiments at Frodsham. If the material of the earth be variable and dry the hemispheroid must become very much deformed and the section very irregular, the lines of flow must spread out further, but the principle is the same, and there must be a resultant return. The general result of the experiments at Frodsham indicates that the depth of the resultant earth was 300 ft., while those at Conway are comparable with a depth of 350 ft. In the case of Frodsham the primary coil had a length and vertical depth of 300 ft., while at Conway the length was 1,320 ft. and the depth was vertically 350 ft. At Loch

Ness and between Arran and Kintyre, where the parallel lines varied from two to four miles, the resultant depth was found to be about 900 ft. The depth of this resultant must therefore increase with the distance separating the earth plates, and this renders it possible to communicate by induction from parallel wires over much longer distances than would otherwise be possible. In establishing communication by means of induction there are three dispositions of circuit available—viz. (a) single parallel wires to earth at each extremity; (b) parallel coils of one or more turns; (c) coils of one or more turns placed horizontally and in the same plane. Mr. Preece has not succeeded in determining satisfactorily the general law which regulates the distance to which one can speak. There are so many disturbing elements, geological as well as electrical. The mechanism of the mode of signalling across space is not difficult to follow. Its analogue is a flash of light seen at a distance. Energy is expended, say, in a lighthouse. The energy assumes the luminous form exciting the ether to undulate with a frequency of many millions per second, which, acting upon the retina of the eye, produces the sensation called light. The burning of the oil-lamp of the lighthouse is the primary source of energy; the rapid undulations of the ether propagated in straight lines, at a velocity of 186,000 miles per second, are the radiations, transmitting this energy in a wave form to the distant ship; the eye is the apparatus which transforms the energy of the light-waves into a form which excites consciousness in the brain. In our electrical experiments the primary energy is the current form; the comparatively few alternations per second excite waves in the ether of a few hundreds per second only. But these oscillations of the ether or electric waves are of the same character as those of light; they move with the same velocity, and when they fall on a sympathetic secondary conductor, they excite in that conductor currents of electricity of the same frequency; and if a telephone be inserted in that circuit, and applied to the ear, sounds and musical notes are distinctly heard, which, by pre-concerted measures, such as the use of the Morse code, can be utilised for the transmission of messages. Thus messages were sent across the Bristol Channel, between Penarth and Flat Holm Island, 3.1 miles away. Speech was maintained in the Highlands across Loch Ness, 1½ mile broad, and telegrams were transmitted from Kintyre to Arran, across distances of four and five miles, and thus we could readily communicate between England and France, or between outlying islands and the shore, when the conditions admit of the erection of the necessary circuits.

LITERATURE AND THE PRESS IN INDIA.

In a recent report of the India-office, it is stated that an Act, passed in 1867 by the Governor-General in Council, for the regulation of printing presses and newspapers, provided, amongst other things, that

every book or paper printed within British India should have printed legibly on it the name of the printer and the place of printing, and (if the book or paper be published) the name of the publisher and the place of publication. It also provided for the registration of every book, pamphlet, map, &c., printed or lithographed in British India. This Act was, however, modified in 1890. The total number of English newspapers published in Bengal during 1892-93 was 40, and the total number of periodicals was 17. Sixty-four vernacular newspapers were published. The number of publications received in the Bengal Library was 1,675, against 2,177 in the preceding year; of these, 289 were in English, 423 were periodicals, 275 bi-lingual, and 977 uni-lingual; of the last class 528 were in Bengali, 202 in English, 71 in Hindu, 60 in Sanskrit, 45 in Uriya, and 14 in Urdu. Of the original works of the year, 205 dealt with languages, 106 treated of religion, 92 of poetry, 65 of science, 58 of history, 44 of fiction, and 33 of the drama. During the year, 1,763 publications were registered under the Act, against 1,550 in 1891-92. In the North-West Provinces and Oude, 23 new papers were started during the year, and 27 ceased to be published, leaving 83 on the register. The majority of the papers are weekly publications—22 are published in Lucknow, 16 in Maradabad, 14 in Agra, 11 in Cawnpore, 8 in Benares, 6 in Fategarh, and 5 in Allahabad. Very many of the papers are devoted to religion, or the interests of a particular community; others concern themselves with local events, while not a few persistently attack the conduct and character of government officials. Of works in the English language there were 61 publications, one more than in the previous year. There were 902 publications during the year, as against 959 in 1891-92. The decline in the number was mainly in publications in Arabic, Persian, and Polygot. In the Punjab, 65 newspapers were published in 1892-93; 13 had a circulation of 500 copies or upwards. *The Tribune*, the only one published in English, had a circulation of 1,400 copies. The total number of publications registered under the Act of 1867 was 1,483, of which 1,098 were original works, and 385 republications; 343 were of an educational, and 1,138 of a non-educational character. Of the 1,483 works, 745 were in Urdu, 308 in Punjabi, 86 in English, 79 in Hindu, 54 in Persian, 48 in Arabic, and 7 in Sanskrit. Forty-seven publications were registered in Burma during the year, against 176 in 1891-92; of these 11 were of an educational and 36 of a non-educational character. Religion was the subject of 23, languages of 11, one treated of law, and one of mathematics, and 7 were dramatic or poetical compositions, 39 were original works, and 8 re-publications or translations. Five of the publications were in English, 18 in Burmese, 7 in English-Burmese, 1 in English-Karen, 1 in Pali, 11 in Pali-Burmese, 1 in Karen, 1 in Sgau-Karen, 1 in Shan, and 1 in French. The total number

of periodicals published in Burma, irrespective of the daily advertising sheets, was 30, of which 5 were printed in the Arakan division, 15 in the Pegu division, 5 in the Tenasserim division, 2 in the Irrawaddy division, and 3 in the northern division. Ten vernacular and English newspapers are published in the Central Provinces. Eight publications were registered during the year 1893, of which 3 were in Hindu, 3 in Marathi, 1 in Hindu and English, and 1 in English. There was nothing last year under the head of literature and the press calling for special notice, as regards Ajmere, Coorg, and Bangalore. There was a great increase in the number of publications registered in Madras during the year, the total number being 982, as against 784 registered in 1891-92. The number of books and pamphlets was 799, and that of periodicals 183. Out of the total number, 695 were original works, 206 republications, and 81 translations. Reprints (without alterations) are no longer brought for registration; and works which are re-published or translated are generally of some value: 242 were published in English, 740 in the vernacular languages spoken in the province. Of the latter publications, those in Tamil (283) take the foremost place, while those in Telugu (199) and Sanskrit (66) rank next. There were 163 poetical works, as against only 59 the previous year. Religious publications numbered 362. A few works on music appeared during the year, their appearance being probably, to some extent, due to the foundation of the Madras School of Music; 272 works were copyrighted, against 240 in the previous year. The total number of publications registered in Bombay during the year was 1,368, viz., 860 books and 508 periodicals. Of these 1,003 were original works, 221 republications not previously registered, and 144 translations. The total was below that for 1891, which was 1,408. The number of books published in English rose from 71 to 82, and that of periodicals from 66 to 95. Gujarati works numbered 430, Mahrati 405, as against 527 and 387 respectively in the previous year. Publications in Urdu rose from 25 to 41, while those in Hindu fell from 22 to 21. In the classical languages there were 43 Sanskrit publications, 4 in Persian, 6 in Arabic, and 4 in Hebrew. The number of works registered for copyright during 1892-93 was 322, against 409 in the preceding year. Of these 274 were private and 48 were Government publications. The literary productions of last year were below those of the two previous years, both in point of quality and quantity. In fact, it would seem that, notwithstanding the spread of education, the amount of original vernacular literature that is yearly published is slowly but surely decreasing. At the end of the year under review, there were in all 148 newspapers and 28 periodicals treating of current matters, against 137 newspapers and 23 periodicals of the previous year. There was no appreciable improvement in the circulation of newspapers over that of 1891-92.

Journal of the Society of Arts.

No. 2,179. VOL. XLII.

FRIDAY, AUGUST 24, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Proceedings of the Society.

CANTOR LECTURES.

THE DETECTION AND ESTIMATION OF SMALL QUANTITIES OF INFLAMMABLE GAS OR VAPOUR IN THE AIR.

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Lecture I.—Delivered January 22.

INTRODUCTORY.

The dangers arising from the presence of inflammable gas in the air seem to have been first encountered and combatted in the coal mine. In the early days of the use of coal, when the seams were worked at the surface, the inflammable gas escaping from the coal naturally gave no trouble. But, in course of time, as the surface supplies became exhausted, it became necessary to "mine" the coal, or to go below the surface of the ground for buried seams. The inflammable gas from the coal under these changed conditions collected in the "workings," instead of escaping at once into the fresh air. The naked candle or torch-flame, which became necessary for illuminating the darkness by which the miner was surrounded, frequently ignited this gas. This led to the miner being burnt by the flame of the gas, and to his being more seriously injured by the force of the explosion, due to the kindling of a mixture of the gas with air.

The earliest attempts to meet this danger consisted in burning out the gas by means of a flame, which was made to traverse the workings. This was effected by the "fireman," before the working miners descended into the mine. Another plan consisted in blowing air

through the mine, by means of large bellows, worked at the surface near the top of the shaft. The upward draft, caused by burning a fire at the bottom of the shaft, was also made to draw a current of fresh air constantly through the mine, the shaft for this purpose being either divided, so as to be able to give a down and up current, or, better still, being connected, by means of the workings, with another shaft at a distance, down which the fresh air descended.

But in modern coal mines a much more certain and efficient means of ventilation is adopted. The mine is invariably provided with two shafts, placed at some distance from one another, and connected by the passages or workings through which the coal is brought, and from which it is won. The air of the mine is drawn out mechanically through one of the shafts, fresh air entering by the other shaft. One of these shafts usually serves for raising and lowering men and coal, and this shaft also serves for the intake of fresh air. Since the fresh air descends this shaft it is known as the "downcast shaft." The other shaft is surmounted by a large exhaust-fan, driven by steam power. The air from the mine is drawn up this shaft by the fan, and the shaft is accordingly known as the "upcast shaft." The fresh air entering by the "downcast" is divided into "splits," each of which goes to ventilate a certain "district" of the underground passages and workings. From each "district" the ventilating currents are united into a "district return," and these are again united into the "main return" current, which passes up the "upcast," being drawn through the fan.

By an arrangement of this kind a current of air may be made to sweep constantly through the mine. This current can be increased at pleasure by augmenting the rate of revolution of the fan, and may be made sufficient to dilute the inflammable gas to such an extent that it cannot be fired or exploded by contact with a flame. But however abundant the ventilating current may be, it will not afford protection against accident, unless it is properly distributed underground. It must be sent in largest quantity to the "working face" of the coal, where the fresh surface of coal is constantly being exposed; and to the "goaf," or broken ground left after the removal of the coal; and evidence is required that the gas escaping from these main sources has been diluted with fresh air to a degree which renders it not only respirable but non-inflammable.

In the case of a mine in which the air is charged with fine coal dust, it has been shown by W. Galloway and others that this dilution must be carried even further, until the air contains less than 0·8 per cent. of gas, if the risk of explosion by contact with a small flame is to be avoided.

It will be seen that the provision of an ample ventilating current of fresh air, therefore, is not in itself sufficient to insure the absence of danger of explosion. It is absolutely necessary also to have a delicate and accurate means of detecting and measuring small proportions of gas in the air, in order to ascertain that the current is properly distributed in the mine. It is now conceded by the highest authorities that, for this purpose, as small a quantity as 0·25 per cent. of gas must be detected and measured. And since the rate of issue of gas from the coal is constantly changing, and the working conditions are subject to frequent alteration, a system of methodical and delicate testing should be constantly maintained, so as to enable the distribution of the ventilation current to be properly arranged.

It will be seen, further, that by carefully testing the "district returns" and the "main return," a general opinion can be quickly formed as to the condition of the air in the whole mine, without making tests in all parts.

Trustworthy and satisfactory methods for gas-testing, which are applicable to the coal mine, are, however, capable of being usefully applied in other cases.

The presence of coal-gas in air may give rise to fire and explosion, as firedamp does in the mine. Coal-gas is not detectible by smell, under certain conditions, and by some individuals. It must also be remembered that it may lose its smell by passage through the earth, and may thus leak into an apartment and attain inflammable proportions without any possibility of its being smelt. Apparently in this way the culverts, in which electric lighting mains are laid, become occasionally charged with an explosive atmosphere, by leakage of coal-gas from the neighbouring gas mains. But it must also be remembered that coal-gas is poisonous, and that even a small proportion of it in the air, if constantly breathed, has been known to produce a disastrous effect upon the health. If the gas has been deodorised, its presence in small, but poisonous proportion, can only be detected by special testing.

Another source of serious accident and

danger is the presence of petroleum vapour in the air. Numerous accidents, many of them causing great damage to property and giving rise to personal injury and fatality, have occurred from this cause. Crude petroleum, and the lighter oils obtained from it, are now largely transported and stored in bulk. The vessels and tanks which contain these liquids, and from which the liquids have been discharged, are constantly furnishing vapour which is in itself highly inflammable, and which when mixed with a due proportion of air is highly explosive. The volume of such vapour, which is necessary to render air explosive, is much smaller than that of coal-gas or of firedamp. This vapour escapes not only from the oil itself but also from the various preparations into which the oil enters as a constituent. The vapour is much heavier than air and, therefore, unlike firedamp and coal-gas, tends to collect at the lowest possible point. Its great density also renders it only slowly diffusive, and tends to delay its escape and its admixture with air. It has been found possible to avoid the recurrence of the disastrous explosions in the petroleum tank steamers, by testing the air contained in the discharged tanks, and only allowing a light to be carried into the tanks after a careful test has proved that the vapour has been entirely removed. Similar precautions will doubtless lead to an equal immunity from danger in dealing with the general storage and use of the volatile oil, and of its various preparations.

These are some of the instances of danger arising from inflammable gases and vapours; but other sources of danger, such as vapour of spirit, of ether and of carbon bisulphide, and water-gas, also occur.

METHODS OF GAS-TESTING IN THE COAL MINE BY FLAME.

It has been already stated that danger arising from the presence of inflammable gas in the air was first encountered in the coal mine. The coal miner soon devised a simple and ready means of detecting the presence of gas, by properly applying the candle-flame which he carried for lighting him in his passage and work in the mine. Trimming the wick so as to obtain a small sharp flame, a pale flame or "cap" was seen surmounting the candle-flame, when gas was present in quantity insufficient to be inflamed or exploded. This cap was so pale that it was perceived with difficulty when the eye was dazzled with

the full light of the flame; accordingly the flame was usually shielded from the eye by the hand, when the cap was looked for. The cap was also naturally best seen when the black surface of the coal or of the coat furnished the background to the flame. The production of the cap was evidently due to the fact that a mixture of air and gas, which contained too little gas to allow the mixture to kindle and burn continuously, could burn when its combustion was aided by the heat derived from contact with or proximity to the flame. This test for gas is certainly not a delicate or accurate one, for reasons which will be subsequently stated. It is also not a safe method of testing, since the candle-flame may be carried into air, containing an inflammable proportion of gas, and may thus lead to fire or explosion. But the test is of great interest, since its development has led to the most satisfactory and trustworthy modern methods of gas-testing.

An attempt was made to avoid the risks arising from lighting the mine by the naked flame, by substituting for the candle-flame the steel-mill. This was a portable arrangement for causing the cogs of a rotating steel wheel to successively strike a stationary piece of flint. A shower of sparks was thus produced, which were stated to be incapable of firing gas. The arrangement was troublesome, as it involved the employment of a boy to carry and constantly work each mill. It was unsatisfactory as a light-giver, and was of course wholly incompetent to act as a means of detecting the presence of gas.

Davy's invention of the safety-lamp presented the miner at once with a reasonably safe illuminating flame, which could also be employed for gas-testing. The simple device of surrounding the small oil-flame with wire-gauze, prevented the flame from kindling firedamp under ordinary conditions, whilst the gauze did not altogether obstruct the light of the flame, or prevent the cap produced by the firedamp from being seen.

The Davy lamp, in its original form, is still in use for gas-testing. If a large proportion of gas is present, the flame of the lamp becomes extinguished by the pale flame of the mixture of gas and air which fills the interior of the gauze. If the gas is insufficient in amount to be kindled within the gauze, its presence may still be indicated by causing the oil-flame to "spire" or stretch itself up towards the top of the gauze, and to begin to smoke. Gas is, however, more satisfactorily detected, and at

the same time roughly measured, by drawing down the wick until the flame has nearly lost its bright tip, and then looking for the cap over this reduced flame; the perception of the cap being aided, if necessary, by shielding the direct light of the flame from the eye by means of the finger. An experienced and careful observer can by this method detect the presence of 3 per cent. of gas in the air, and by observation of the height of the cap he can estimate with fair accuracy the per-centage of gas present from 3 to 6 per cent.

The Davy lamp, soon after its introduction, was subjected to modification. One of the alterations introduced consisted in the replacement of the lower part of the gauze of the lamp by glass. This improvement has been adopted in all the modern forms of safety-lamp, and it adds considerably to the lighting power of the lamp, since the partially opaque gauze is replaced by the transparent glass. Even for lighting purposes, however, the introduction of the glass was not wholly a gain, since the combustion of the flame was rendered less rapid. This is due to the fact that the direct flow of air to the flame was impeded, and in many forms of lamp the air on entering the lamp became also mixed with products of combustion of the flame, and was therefore not as well suited to maintain combustion as fresh air would be.

The introduction of glass around the lamp-flame was, however, a serious hindrance to the application of the lamp to gas-testing. The front of the gauze of the Davy lamp constitutes an obstruction and cuts off some of the feeble light of the cap, and undoubtedly the gauze behind the cap is not an ideal background against which the cap may be observed. The glass cylinder, which surrounds the flame in modern safety-lamps is certainly, when clean and bright, transparent, and does not obstruct the light as gauze does. In this condition, however, its highly reflective surfaces behind the flame produce images of the flame and cap, which baffle all attempts at accurate observation of a small and pale cap; whilst, when the glass becomes soiled by the burning of the flame, it practically prevents a small cap from being seen at all in the presence of the luminous flame of the lamp.

The Davy lamp, as compared with the Clanny and other modified forms of lamp, is therefore reasonably preferred for gas-testing. The air, which is to be tested, impinges directly and undiluted upon the lamp-flame, causing the indications of gas to be prompt

and full; and although the gauze obstructs some light, it does not give rise to interfering and confusing reflection images, and it does not have its transparency impaired during use, as glass does.

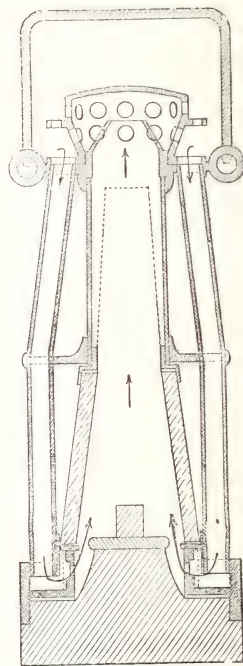
The interference caused by reflection of light from the back of the lamp glass has been recently prevented by grinding or etching the inner surface of the back of the glass. A permanent dead-black surface has also been produced by burning in suitable substances upon the surface of the glass. I have found no surface so satisfactory, however, as that produced by smoking the glass by means of the flame of a wax match or taper. This surface is excellent while it lasts, but it has the disadvantage of requiring renewal each time the glass is cleaned. By careful observation with a glass thus prepared, 2 per cent. of firedamp in the air has been found to produce a cap over the reduced oil-flame of the lamp, which is perceptible under the most favourable conditions.

MM. Mallard and Le Chatelier, in 1881, described a safety-lamp which was provided with blackened metal screens before and behind the flame. The screens were of such height as just to conceal the lamp-flame when it was drawn down for gas-testing. The light of the flame was thus prevented from dazzling the eye and from reaching the lamp glass and suffering reflection. The cap was also examined against a black screen or a surface of black cloth attached to the interior of the back of the lamp glass. This arrangement placed the oil-flame under the most advantageous conditions possible for the perception of the cap. The inventors accordingly seem to have observed a cap in air containing only 1.5 per cent. of firedamp. They were even able to note the presence of 0.5 per cent. of the gas, although this observation could not apparently be relied upon in the mine.

Of the many different types of safety-lamps which have been brought forward, that which is probably best suited, by its construction, for gas-testing is the Gray lamp. The best form of this lamp is that which has been produced by the modifications of Messrs. Ashworth and Hepplewhite, and is therefore known as the Ashworth-Hepplewhite-Gray lamp. It will be seen, from the section of the lamp (Fig. 1), that this lamp takes its air-feed from near the top, the air passing down through side tubes to beneath the level of the wick-holder. It then passes through a ring of metal gauze, and reaches the flame

directly, without undergoing admixture with any products of combustion. These products pass through an upper gauze-cap, which is cased round with a brass tube, and then escape through an exit in the middle of the crown of the lamp. This lamp, therefore, enables the air close against the roof of the mine to be tested, by simply pushing the lamp up until its top is in contact with the roof. It is close to the roof, and especially in hollows or "pockets" in the roof, that the accumulations of the light firedamp are most likely to occur and to be detected.

FIG. 1.



ASHWORTH-HEPPLEWHITE-GRAY SAFETY-LAMP.
(Section).

Since the flame would be extinguished when the lamp is fed with air containing high proportions of firedamp, such as might occur near the roof, the air tubes of this lamp are provided with side openings at their base, which can be closed by brass "sleeves" when the openings are not in use. These holes are closed with the tips of the thumb and fingers, when the lamp is used for examining the roof. If the lamp flame shows signs of extinction by air drawn in from above, the holes are opened by removing the fingers, and the extinction of the flame is then prevented by the admission of air drawn from a lower level, and, therefore, containing less gas. It will be seen

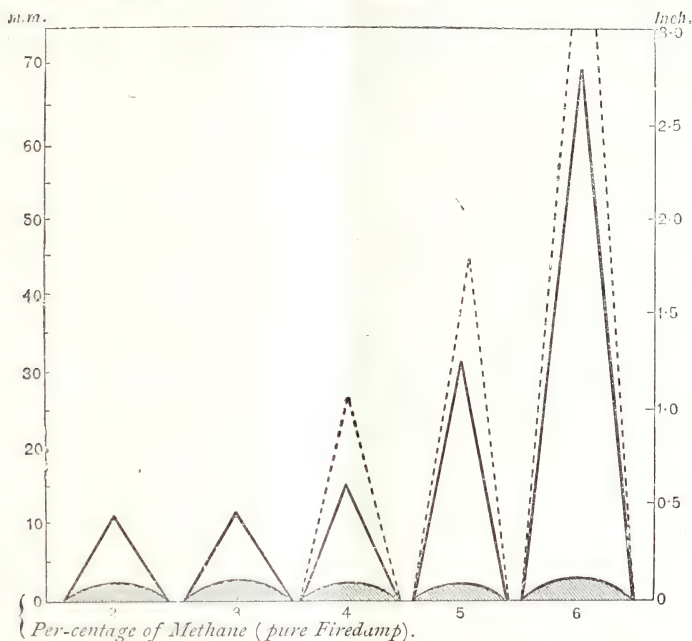
that the construction of this lamp provides for the "bonnetting" of the gauze, both the lower and upper gauze being surrounded with continuous sheets of metal. These prevent air from being mechanically blown through the gauze so as to force flame through it.

I have found that this lamp, when provided with a glass properly blackened behind, gives good, though not sufficiently delicate, results in gas-testing. A flat-wick flame was pro-

duced by burning a mixture in equal measures of colza oil with petroleum (water-white) oil, and the wick was drawn down until the luminosity of the flame was destroyed as nearly as was possible without extinguishing it. A very pale cap was then visible in air containing 2 per cent. of gas. Caps could be easily observed over this flame when per-centages of firedamp varying from 3 to 6 were present in the air (Fig. 2).

FIG. 2.

ACTUAL HEIGHTS OF CAPS OVER COLZA-PETROLEUM FLAME.



The pale blue flame, 3 mm. in height, is shown shaded.

The partly luminous flame, giving maximum caps, is not shown, but the cap-heights over it are dotted in.

The heights of these caps are recorded in the Table (p. 798). The height of the cap could be increased by only drawing down the wick in the air containing the gas until the cap just became visible. This usually left a larger flame than that described above, and the larger flame produced a correspondingly larger cap. These larger caps are represented by dotted lines in the figure. Some variation was always noticed, however, in the readings of the cap-height in air containing the same per-centage of gas, since it was impossible to bring the flame in repeated experiments to precisely the same adjustment. Even when the wick had been set and remained untouched, the flame gradually suffered alteration in size, and this

led to an even greater alteration in the height of the cap.

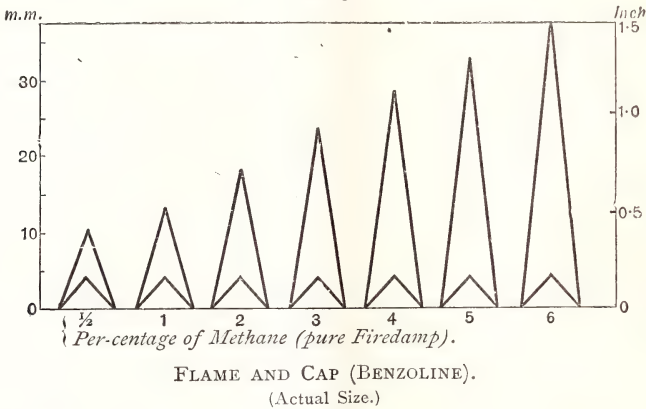
The admixture of petroleum with the colza oil in feeding this lamp had the advantage of considerably impeding the charring and crusting of the top of the wick. The formation of this hard crust on the wick is one of the most troublesome occurrences during gas-testing. It leads to the formation of most unsatisfactory gas-testing flames, since the reduced flame is apt to suddenly die out, and is also rendered luminous by particles of the crust projecting into the flame and becoming red hot. The presence of the petroleum, however, is also attended with disadvantage, since it gives rise to the formation of a small cap or halo over the

flame even in gas-free air; this is naturally confusing in delicate gas-testing, when a small faint cap is looked for, and its detection is taken as an indication of the presence of gas.

The combustion of benzoline, or light petroleum oil, in the lamp in place of ordinary oil, has been advocated by Wolff in Prussia and by Ashworth in this country. The use of benzoline entirely obviates the charring of the wick, but it unfortunately gives rise in a more pronounced degree, even than ordinary petroleum does, to a distinct cap or halo over the flame in gas-free air. Mr. James Ashworth has introduced a form of benzoline burner into his modified Gray lamp, which has been already described. This burner presents many

advantages in gas-testing. A permanent metal screen is fixed around the wick-tube. This screen is of such a height that it just conceals from the eye the reduced flame, which is used for testing purposes. The lamp-glass is roughened at the back so as to prevent reflection, and is coloured blue to assist in the perception of the cap. This benzoline flame, when it is raised to the verge of smoking, gives a very satisfactory light. When it is reduced by means of a very convenient and gradual rack-movement, it loses its luminosity almost entirely, and becomes therefore well suited when withdrawn behind the screen to permit the caps to be seen. The caps seen with this lamp are small but distinct. (Fig. 3).

FIG. 3.



HEIGHT OF TEST-FLAMES AND OF FLAME-CAPS.

Per-centage of Methane (Firedamp) present.	Ashworth's Benzoline flame, height 3 mm. Height of cap.	Colza-petroleum flat flame.	
		Small blue flame, height 3 mm. Height of cap.	Flame partly luminous, height 6 mm. Height of cap.
0.25	—	—	—
0.5	7 (?)	—	—
1.0	10	—	—
2.0	14	7.5	7.5
3.0	20	7.5	7.5
4.0	25	12.0	24.0
5.0	30	29.0	41.0
6.0	35	67.0	{ enters top of lamp.

Multiply millimetres by 0.04 to convert them to inches.

The certainty of perception of the smaller caps is interfered with by the faint halo always perceptible over the flame, but when the proportion of gas present varies from 1 per cent. to 6 per cent. the indications are distinct though small. They are interfered with to a less extent than is the case with most wick-fed flames, by the uncertainty of setting the flame always to the same invariable standard. The average readings of the heights of the oil and the benzoline flames, and of their caps, are given in millimetres in the Table.

The benzoline flame yields the indications of gas by "spiring" more satisfactorily than oil-flames do. In making these tests the flame is raised until it is on the verge of smoking. When the flame in this condition is brought into the presence of gas, it suffers an elongation. This elongation increases with the quantity of gas present. Whilst being drawn up in height, the flame also commences to smoke. My experiments show that an ordinary oil-flame in the safety-lamp lengthened

by about 0·1 inch when exposed to air containing 1 per cent. of gas. This was the smallest indication of gas which could be perceived. With the benzoline flame, spiring was distinctly perceptible in the presence of 0·5 per cent. of gas. The detection and measurement of these small per-centages of gas by the spiring of the flame is, however, not trustworthy. Two per cent. of gas and upwards may be detected with more certainty. But both low and high proportions of gas are more satisfactorily noted and measured by suitable flame-cap observations.

Spiring is due to diminished supply of oxygen to the flame. This arises partly from the admixture of gas with the air, and partly from the removal of oxygen in the neighbourhood of the flame, owing to the combustion of this admixed gas. But this diminution of the supply of oxygen to the flame may be due to various other causes besides the presence of firedamp. Amongst these may be mentioned the following :—

1. Rise of temperature in the air.
2. Admixture of carbonic acid with the air.
3. Obstruction in the gauze by oil or dust, or by soot deposited by the spiring flame itself.
4. Motion of the lamp, or of the air around the lamp.

It must also be remembered that any change in the wick, or in the rate of supply of oil to the wick, after the flame has been set, will alter the sensitiveness of the flame for the test. Such alterations readily occur. The flame must also always be set in gas-free air, else its indications by spiring are not absolute, but only relative. Bearing in mind that this test is not a direct test for firedamp, and that its indications are falsified by the presence of carbonic acid, and by many commonly-occurring conditions, the observation of the spiring of the flame cannot be recommended either as an accurate, delicate, or trustworthy method of gas-testing.

Miscellaneous.

ON ENGINEERING LABORATORY INSTRUMENTS AND THEIR CALIBRATION.*

BY DAVID S. CAPPER, M.A.,

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The reliance to be placed upon observations made with measuring instruments evidently depends pri-

marily upon the accuracy with which those instruments record. Neglect of this fundamental truth often leads to inaccurate and erroneous deductions from experiments which are themselves of the highest scientific value; not infrequently the whole value of observations may be destroyed by insufficient care in the calibration of the instruments used. The subject is, therefore, one of some importance. The author describes the chief sources of error in some of the most common engineering investigations, and their probable value, and points out some of the possible methods of correction where such exist. For example, in engine trials there are many possible sources of error. Most of these may be reduced in per-centage value by continuing the trial for a sufficient period. But this is not the case with errors which may occur in the indicators, gauges, or spring balances used in the determination of power. In these, unless properly calibrated before trial, very serious errors may be introduced, amounting in some cases to 5 and 6 per cent. of the total power indicated. It is therefore absurd, even if proper precautions have been taken, to rely upon horse-power measurements to two places of decimals.

Similarly with regard to tension and compression experiments with standard 10-inch bars. Here calibration of the testing machine is extremely difficult, and can in general only be carried out over a small portion of the experiments. Deductions have, therefore, to be made from the less to the greater, with the result that small errors in the calibration will tend to be magnified. Vertical testing machines have fewer sources of error, and can be calibrated with more certainty, than horizontal machines. Extensometers are, however, much more easily applied to a horizontal bar than a vertical, and variable jockey weights, which are requisite if the same accuracy is to be maintained at low loads as at high, are also more readily adapted to horizontal machines.

Extensometers can be made and calibrated well up to the accuracy of the testing machine. With standard bars and a measuring instrument true to the ten-thousandth of an inch, the modulus can be relied upon to the second significant figure. It is doubtful if more can be obtained without very special construction and calibration of the testing machine.

The difficulty in bending experiments, again, lies in the accurate application of load. Unless the beams are very short or of unmanageable cross-sections, the load measurement must be very delicate if readings approaching the accuracy of those in tension are to be obtained. It is possible that some of the discrepancies in published beam experiments may be due to this cause.

The paper deals shortly with other cases where calibration is specially needed, to which the limits of this abstract do not permit a more extensive allusion.

* Paper read before Section G of the British Association Meeting at Oxford.

*CONTINUOUS CURRENT DISTRIBUTION
OF ELECTRICITY AT HIGH VOLTAGE
AT OXFORD.**

BY THOMAS PARKER, M.Inst.C.E.

The Central Station at Oxford was started in the middle of the year 1892, and is equipped with high-tension continuous-current dynamos, driven by means of belts from triple-expansion vertical engines; it is placed 1,500 yards away from the area of lighting. The current is distributed by means of a network, which is fed by motor generators which transform from 1,000 to 105 volts. These motor generators are started, stopped, and regulated from a central switch station placed in the area. The main feature of the system is the complete control of the motor generators from the switch station; and the number connected on to the network being varied to suit the load, it is possible to always work the transformers at a high efficiency. A small battery situated at the switch station is used to supply the small day and night loads, thus enabling the Central Station to be entirely shut down for a great portion of the twenty-four hours.

The figures for 1893 show that the total efficiency of the system was 61·62 per cent., and the efficiency of the motor generators was 74·44 per cent., including losses in mains and resistances. This is not so high as it will be in the future, when the lamps are more evenly distributed over the area. The battery efficiency was 50·64 per cent. The actual coal used throughout the year works out to 6·83 lb., or 718d. per unit sold, which is a very good result, as only slightly over 100,000 Board of Trade units were metered. The oil, waste, water, and general engine-room stores work out to 0·657d. per unit metered. The total number of lamps installed at the beginning of the year was 4,041, which increased to 7,012 by the end of the year. As the great proportion of supply is taken up by colleges, the term-time is the only part of the year when anything like a load can be obtained, and the load factor is only 6·31 per cent.

The revenue during the year under notice was 10s. 11d. per 35-watt lamp installed.

Correspondence.

*SOME REMINISCENCES OF STEAM
LOCOMOTION ON COMMON ROADS.*

The following note is sent by Sir Frederick Bramwell, who wishes that further detail should be given as to the construction and mode of manufacture of Hancock's Flat Chamber Boiler:—

Each chamber was made in the manner in which a biscuit bag is formed, that is to say, a sheet of copper

or of very soft iron, of a length equal to double the height of the chamber and of the breadth of the chamber in width, was taken and bent in the middle over a round bar of a diameter equal to the intended distance between the two sides of the chamber (say two inches), and then the two sides and the top were brought together and rivetted through, thus completing the biscuit bag construction; or more commonly, channel irons, of the same thickness as the plate, and with half-round top and bottom, were prepared, and were placed in the sides of the chambers, with the flat part of the channel internal, and were then rivetted through the projecting edges, the top plate having been previously bent over the bar that had been used for the bending of the bottom.

Prior to the plate being bent over the bottom bar, it had been laid on a cast-iron mould, furnished with hemispherical indentations, into which the plate had been forced by hammering, so that when bent up into the biscuit bag form, its two surfaces were furnished with a number of hemispherical bosses.

Ten, or any desired number of these chambers, were then placed side by side, like books on a shelf, the summits of the bosses of one chamber abutting on the summits of the bosses of the chambers on each side of it. Against the outside of the two external chambers were placed two very strong wrought iron plates of the whole size of the chamber, and outside these plates were horizontal girders a little longer than the width of the wrought plates, so as to admit of tie-bolts passing across the boiler from girder to girder. By means of these bolts, and by two other bolts to be presently mentioned, the whole group of chambers were tightened up together, the summits of all the bosses bearing, throughout the chambers, and taking the pressure of the bolts.

Two other tie-bolts have been mentioned; these, in combination with certain gun-metal rings, not only assisted in holding the chambers together, but also served, in the following manner, as the water connection at the bottom of the boiler, and as the steam connection at the top:—

Before each chamber was rivetted up, there was introduced in the middle of it, and near to the bottom, a gun-metal ring, say of three or four inches internal diameter, and having a number of radial holes through it, which ring was received into protuberances having an elevation above the general surface of the side of the chamber, equal in height to the projection of the bosses. Thus, when all the chambers were placed side by side, they touched in the neighbourhood of these gun-metal rings, except that there was left sufficient space to take a ring of copper wire to make a joint. It should have been said that holes were cut in the sides of the chambers to correspond with the holes in the gun-metal rings.

External close-ended rings were provided, and on these ends bore the nuts of a tie-bolt which, passing through the whole of the rings and chambers, not

* Paper read before Section G of the British Association Meeting at Oxford.

only served as had been said, to screw them firmly together, making tight joints by means of the copper wire, but owing to the tie-bolt being very much smaller than the holes in the rings, served to make a free annular water connection among all the chambers. The close ended external rings received at one end a feed-pipe, and at the other end a blow-off cock.

In the middle of the boiler, and near to the upper end of it, was a corresponding tie-bolt, with this difference, however, as regards the rings, that there was not any protruberance upon the sides of the chambers, and that, therefore, the rings within the chambers were as narrow as the chambers themselves, and that external to the chambers, and in the space between each neighbouring pair of chambers, corresponding rings, but of course without radial holes, were employed as distance pieces. This enabled the steam-pipe to be taken off from the very middle of the boiler, so as to obtain a more uniform flow for the steam from all parts of the boiler than would have been practicable if, like the feed-pipe, or the blow-off cock, the steam-pipe had been taken off at the end of the annular tube. These ends were used for the safety valves.

This description, it is feared, may be thought too long and too minute, but it is needed, in order to make clear the extremely ingenious character of this—now practically forgotten—boiler; and, in the absence of drawings, it has been found impossible to make it more concise.

THE NATIVE SWEETMEATS OF BOMBAY.

The article reproduced from the *Revue d'Orient* in the *Journal of the Society of Arts*, of the 27th ult., on the sweetmeats of Turkey, has more than an industrial and commercial interest. The cookery, and particularly the confectionery of the Eastern nations has hitherto proved the most stable and unalterable of their arts, and is well worthy of learned study as a branch of archaeology. Recognising this, so long ago as 1862 I published in the first edition of my "Catalogue of the Economic Products of the Bombay Presidency" what I believed to be an exhaustive list of the sweetmeats made and sold in the chief bazaars of Western India, with short recipes for making them up; and I would hope that the transfer of this information to the pages of the Society's *Journal* will not only make it accessible to a wider circle of readers, but lead some of them, either in this country, or in the Levant, or Persia, or India, with more leisure than I can command, to further pursue the subject. I exclude from consideration all dried and candied fruits [*trōgālia. tragēmata*], jams, jellies, sherbets [*sharab*], whence, also, our word syrup] or sweet-flavoured beverages, fruit puddings, pies, and tarts, and, of course [aromatic], savouries of all kinds, and restrict myself to confections of which honey, or, as in India, sugar, is the whole or, at least, the principal

constituent; that is, to sweetmeats proper, or, in the slang of our English nurseries, "lollipops." Only our "lollipops" are not true "lollipops," for they consist entirely of baked, or, in technical language, "hard" confectionery, whereas Eastern sweetmeats are nearly all "soft," being mostly prepared by boiling, or steaming, and are true "lollipops," that is, "food" [*papa*, compare "papa," the "feeder," and *papa-ver* the "soother"] "to be licked" or "sucked down" [*lallein*], and not to be chewed or masticated. That is, they are all electuaries [*ēk* "out," *leichein* "to lick" or "suck"] in the etymological sense of the term, which, however, is now applied only to medicated preparations of honey or sugar; and they exactly correspond to the *nōgalesimata* [compare *nougat*] of the ancient Greeks.

The sweetmeats of Bombay are made up of either sugar [*shakar*] only, or sugar and meal, or flour, of wheat, or other cereals, or pulse grains; or of sugar and milk; or of either of these three preparations further confected with sesamum seed [*til*], poppy seed [*cus-cus*], pistachio nuts, almonds, *chironji* [the kernels of *Buchanania latifolia*], or other flavouring ingredients, chiefly spices, such as cardamoms, or any two, or three, or more of these adjuncts: and they are nearly every one of them true lambitives. Eastern sweetmeats, especially those of the Hindus, being for the most part boiled, are whitey-brown, or drab-coloured, and hence the general term for them is the Arabic word *halwa*, literally "drabs," even among Hindus, whose own name for them is *methai*, "sweets," and the Persians, whose native name for them is *nubat*, or, when offered to their saints, *shirini* ["sweetness"]. *Halwa*, indeed, means, in Arabic, "to be sweet," but that is probably not the primary, but the secondary, meaning of the word, the familiar all-pervading "drabs" being sweet.

I will now enumerate the native sweetmeats of the Bombay bazaars, under the heads already indicated:—

First, of Sugar only.

1. *Batas* or *batasa* [literally "air," "foam," "froth"], a circular, plano-convex, brittle, spongy, lozenge-like sweetmeat, of pure sugar, which melts in the mouth with the tantalising suddenness of a ripe mulberry, but leaving behind a full flavour of true saccharine sweetness never yielded by our mawkish American and French "lollipops;" made, as these are, of either chemically-treated cane sugar or beetroot sugar. There is a Hindu proverb, *batasa-ghulna*, "to fade away like a *batasa*," to die of galloping consumption.

2. *Batasi laddu*.—*Laddu* means "load," "burden," "freight," "bowels," "beloved," "wife," "daughter," and, here, "lump," "bolus," and here is a ball of pure sugar prepared in the same way as for *batasas*. The *laddus*, as will be seen below, form a large class of Hindu sweetmeats, and have originated a variety of proverbial sayings as *laddu*-

khelana, "to feast one with *laddus*," i.e., to bribe; *Thag ke laddu khana*, literally "to eat Thug's *laddu*," to be taken in and done for; *laddu bantna*, "to distribute *laddus*" in congratulation over one's good fortune; and *man ke laddu khana*, "to suck imaginary *laddus*," to indulge vain fancies.

3. *Shakar - ka - khél*, "sugar," prepared as for *botasas*, but not so brittle, and moulded into "toys" for distribution during the *kivali* holidays, or Hindu "feast-of-lanterns" [literally "lights"], held in the new moon of *Kartik*, corresponding with October-November.

4. *Har - ganti* [literally "necklace knotted"], necklaces of knotted sugar, distributed during the *Holi* [Easter] holidays, or Hindu festival of the vernal equinox, held throughout the light half [new to full moon] of *Phalgun*, corresponding with February-April.

Second, of Sugar with Flour.

5. *Julabi*, or *julábi*, made up with sugar and flour, boiled, and then drained through a wooden spoon, with a hole in the bottom, in circular coils, into a vessel in which it is fried for a while in a boiling mixture of sugar and *ghi*, or clarified butter. The coils are hollow like macaroni, and, in frying, become filled with the greasy syrup in which they swim. It is very delectable stuff taken fresh, and then well deserves the synonym, *amrita*, i.e., "ambrosia" applied to this and other Indian sweetmeats by the Hindus. But *ghi*, from its so soon turning rancid, is the bane of the Indian sweetmeats into the composition of which it enters in cooking. I do not know the meaning of the word *julabi*. It may be formed from the Arabicised Persian word, *gulab* [from which our word "julep" is formed], "rose water," but it contains no rose water; but neither do purgatives, which in India are generically denominated *julab*; or it may be derived from *jhul*, a swing, being one of the sweetmeats used at the *jhulan-jatra*, or "swinging fair," held during the *Holi* holidays in honour of Krishna and Raoba.

6. *Satar-phani*, or *tar-phani*, is made of the same ingredients as *julabi*, but drawn into fine threads [*satar*, *tar*] like vermicelli, felted, as it were, into large globular cakes [*phani* ?].

7. *Mal-puri*, identical with the last, only felted into the shape of small pancakes. I do not know the full meaning of this descriptive name; *puri* means "cake."

8. *Khaja* ["eat!"], the same mixture, with very little sugar in it, and, after boiling, slightly fried in *ghi*, in a mass resembling dry pie crust.

9. *Singér* ["a horn"] the same as the last, but shaped like a pasty.

10. *Masur*, literally "lentils," but in Bombay gram [*chana*], boiled up with sugar, and cut out into cubes.

11. *Chana-papudi*, "cakes" of sugar, and split "gram." Compare the Greek *popós-ádos*, and *pópanon*, or sacrificial cake. The *papud* of gram,

savoured with *assafoetida*, eaten with curry, is familiar to all Anglo-Europeans.

12. *Moti-chur-laddu*, sugar, gram flour, and wheat flour in large balls. A finer variety is called *dalia laddu*.

13. *Shakar-chana*, hard, nodular comfits of sugar and "gram."

14. *Kali-ke-laddu*, soft ditto.

15. *Bundhi-ke-laddu*, the same as the last, but larger and rounder.

16. *Besan-ke laddu*, *laddu*, gram, flour, and sugar, boiled, and moulded into large balls.

17. *Mung-ke-laddu*, a similar shaped sweetmeat, of sugar and *mung* flour [*Phaseolus Mungo*].

18. *Udit*, or *Urid-ke-laddu*, ditto, of sugar, and the flour of a variety of *P. Mungo*, called *urid*.

19. *Churma-laddu*, ditto, of sugar and wheat flour, or *suji* ["semolina"], or even "crumbled" bread, the literal meaning of *churma*.

20. *Gugun-ganti*, cylinders of sugar and flour.

21. *Gulabi-jamb*, the same ingredients, similarly made up, this variety deriving its name—why, I cannot say—from the rose apple, *Jambosa vulgaris*.

22. *Gulab-chiri*, or *shakar-ka-chiri*, sugar and flour in long "sticks," crooked at one end.

23. *Ghugari*, ditto, made up into a sort of comfit by frying in *ghi*.

Third, of Sugar and Milk.

24. *Barfi - sadi*, "true," "pure," "simple," "plain *barfi*," *barfi* being a Persian word meaning "icy," from *barf*, "ice." It is made by simply boiling down milk and sugar, and cutting the luscious and cooling paste thus formed into cubes, which, except in shape, and the substitution of sugar for honey, resemble the *chória* of the Greeks.

25. *Dud-pedda*, the same ingredients, similarly prepared, and made up in balls. *Dud* here means milk; what *pedda* means I do not know; it may be the same as *pera*, *piri*, *puri*, "a cake."

26. *Mawa*, ["pale"] amorphous *dud pedda* or *barfi*.

Fourth, any of the above, compounded with various Nuts, Seeds, &c.

27. *Halwa*, the sweetmeat *par excellence* of the Levant and Hither and Southern Asia. It originated among the Arabs, and by them is made of honey and pounded fresh wheat, boiled in camels' milk, and flavoured with cardamoms. It is either run into shallow saucers, in which, while yet hot, it is covered over with blanched almonds, or allowed to cool in mass, when small portions of it are done up in fine matting of date leaves. The *halwa* of Bombay is very inferior to this, being compounded of sugar, flour, or else *suji*, and milk, flavoured with cardamoms and stuck over with almonds [*badam*]. In its amorphous form, which is without cardamoms, it is known as *shira*, "cool." In its other varieties it is either formed into cubes, called *badami halwa-vola* when moist, *badami-halwa-suka* when "dry," and

badami-halwa masalaki when spices [*masala*] are added in the preparation, or cut in slices, known as *dewka-halwa*. As prepared by the Arabs, it would seem to closely resemble the *'ámulos* of the Greeks, with which the *rahat lakoum* of the Turks is probably identical. A variety, caused by baking *halwa* into a kind of "toffy" [*taffie*, "candy," Angliæ borealis], is known in Northern India under the name of *halwa-sohan*, derived from its inventor, one *Sohan Lal*.

28. *Dudi ke halwa* consists of slices of gourd boiled in a syrup of sugar, spices, and milk. It may be compared with the "catillus ornatus" of the Romans.

29. *Rivadi*, soft lozenges of boiled sugar stuck full of sesamum [*til*] seeds, and, except that sugar is substituted for honey, identical with the *sesamides*, and closely resembling the *'ltrion* of the Greeks.

30. *Narsa*—similar cakes, covered with poppy seeds [*cus-cus*]. They seem to be identical with the *koptai* of the Greeks, and often opium is added to them, blackening them like the similarly drugged Greek *koptè*, called *gástris*.

31. *Nankatai*, rich cakes of flour, sugar, almonds, and cardamoms, and other spices, prepared by the Mahometans of Surat, and exported thence to Bombay. It is very desirable to know the etymology of this word. I can give no clue to it. *Naknank* is a Sanskrit term for sky, ether, heaven, paradise; and *Nak-nati* is the name of one of the Apsaras, or "Sisters of Mercy," of the heaven of India; but this, like nearly all spiced Indian sweetmeats, is a Mahometan invention. Again, *nan* in Persian means cake [?] from the consecration of cakes in ancient Persia to Nana-Tanita, and *Katai*, Cathay, and *nankatai* may mean "Chinese-cake." But this is all mere guessing. These cakes, in shape, may be compared with the *milloi* of the Greeks, and our "Maid of Honour."

32. *Barfi masala, barfi* with added pistachio nuts, *chironji*, and spices [*masala*].

33. *Gur-dani*, "grains," i.e., soft sugar plums, of earth nuts [*Arachis hypogea*] embedded in raw sugar or molasses [*gur*].

34. *Narli-pak, a laddu* of boiled [*pakta*] sugar and "cocoanut."

35. *Dud-pedda-masalaki, dud-pedda* with spices.

36. *Methi-laddu, a laddu* flavoured with "Fennugreek."

37. *Musalaki-laddu*, any of the above *laddus* with spices added.

38. *Gul-khand*, a conserve, rather than sweetmeat proper, of pounded sugar-candy [*shakar-khand*], "rose" leaves, almond paste, and cardamoms.

39. *Mawa ke kurinji, mawa* with pistachio nuts and spices added, formed into the shape of a pasty, covered with sugar, and baked for a while.

40. *Kurinji*, a small pasty of *mawa* containing a mixture of sugar, cocoanut, poppy seed, and spices,

41. *Yelchi-dana*, "cardamom-grains," i.e., soft comfits of cardamoms.

42. *Kaju-gola*, soft sugar-plums [literally "pills," "balls"] of Cashew nuts [*Anacardium occidentale*].

43. *Til-dana*, "sesamum grains," i.e., soft comfits of sesamum seed, which are distributed in tens of thousands of tons over all India at the festival of *Makar Sankranti*, held in celebration of the sun, in his yearly course, reaching his southmost point in the sign of the Makara or Capricorn. The whole period of his descent from his northmost point in Karkata, or Cancer, is unlucky; but every day of his ascent from Capricorn to Cancer the gates of heaven are open to all mankind, and the whole period is more or less auspicious. Hence the rejoicings with which the day of the sun's again turning northward is hailed. It is nature's Christmas-day, and its crowning ceremony is the tour of visits made in the evening of *Makar Sankranti* by the Hindus of every caste among their friends, to offer each other these sesamum comfits with the truly Christian salutation: "Take these sesamum comfits, and let us be friends throughout the coming year." Only the sun, "the Sun of Righteousness with healing on his wings," is worshipped by them on this day.

The subject is too large to enter on now, but it must not be overlooked that every Indian sweetmeat is originally of sacramental import, as is seen at once in the elaborate ritual of the whole cooking arrangements of the Hindus. All the pots and pans are placed towards the East, the hearth and fire towards the South-East, the firewood to the South, the spoons and knives to the South-West, the water on the West, the pestle and mortar to the North-West, the sacred winnowing basket and the broom to the North, and the grinding stone to the North-East. The size of these various utensils is determined by the minutest and most inflexible ritual; and so on to the end of the chapter.

But here I am only concerned to express the conviction formed, after years of intimacy with the question, that the "soft" confectionery of the East has never materially changed from the highest antiquity of Egypt and Assyria and Babylonia; and that we see it in the bazaars of Cairo, Damascus Shiraz, Teheran, and Cabul, and of Lahore, Calcutta, and Bombay, just as it is described by Athenæus in the 3rd century, A.D. The observation applies with almost equal force to Eastern cookery generally. A most appetising "savoury" is served during the cold season at the corners of the streets of Bombay "hot and hot" to every passer-by, and it always reminded me of the *tagéniai* of the Greeks. Curry is certainly the *míma* of the Greeks, and nothing could possibly be more like their *póltos* than the sweet pult of vermicelli, almonds, *chironji*, sesamum seed, poppy seed, sultana raisins, and sugar candy, all boiled in milk, and served cold at breakfast in most well-to-do native households.

Another generalisation may be noted, the remarkable absence of saffron from Indian confectionery. The Phenicians carried its use in cookery from Cilicia to Cornwall and South Devon, in the West, to the coasts of the Indian Ocean, in the East; and to this day its use prevails in the popular cookery of Cornwall and South Devon, as in the "Anderson's Buns" of Plympton St. Mary's, and culminates in the *bouillebaise* of Southern Europe. The fisher folk of Western India also largely employ it in their special preparations of curries and similar stews, but it is never anywhere found in the confectionery of the Hindus; a pertinent illustration of the conservative virtue of the severely detailed ritual of Hinduism, and of the merely peripheral and superficial action of foreign influences on India.

GEORGE BIRDWOOD.

Obituary.

LORD DENMAN.—Thomas, second Lord Denman, who died suddenly at Berwick-on-Tweed, on the 10th inst., was, at the time of his death, a member of the Society of Arts of over thirty years' standing, having been elected in 1862. He was born in London in July, 1805, and succeeded his father, the famous Lord Chief Justice of the Court of Queen's Bench, in the peerage in 1854.

WYATT PAPWORTH, F.R.I.B.A.—Mr. Wyatt Papworth, curator of Sir John Soane's Museum, died at the museum on Sunday, 19th inst., aged 72 years. Mr. Papworth was distinguished by a wide and accurate knowledge of the history of architecture. His great work—the "Dictionary of Architecture"—issued by the Architectural Publication Society, was commenced in 1852, by his late brother, Mr. J. W. Papworth, and himself, and was carried on until its completion in 1892, under his own sole editorship. He contributed many valuable papers to the Transactions of the Royal Institute of British Architects, two of which may be specially mentioned, viz., "The Superintendents of English Buildings in the Middle Ages, with especial references to William of Wykeham" and "Collections for an Historical Account of Masons, their customs, institutions, &c." These were originally printed in 1860-61, and reprinted, with additions, in 1887. Mr. Papworth possessed an exhaustive knowledge of the dates and history of the various London buildings, and he was always ready to help others from the vast stores of his learning. He was a past Master of the Clothworkers' Company, and was elected a member of the Society of Arts in 1889.

General Notes.

PHOTOGRAPHIC SOCIETY.—A Technical Meeting on Limelight Apparatus will be held at 50, Great Russell-street, on the 28th inst., at 8 p.m.

ITALIAN WOOL PRODUCTION.—Italy produces annually about 10,000 tons of raw wool, the value of which is given at £720,000. The exact amount, according to the official returns, amounted, in 1892, to 9,958 tons—an increase of 33½ tons over the production of the previous year. This difference was accounted for by the richness and abundance of the pasture lands. The provinces contributing to supply this increased production are Perugia (Umbria), Rome, nearly all the Southern Adriatic provinces, and the province of Cagliari. Distributing the production according to the various provinces, it is found that the Southern Adriatic supplies the greatest amount, 2,620 tons, then come the Sicilian, the South Mediterranean, Sardinian, Tuscan, and Umbrian. The Ligurian provinces come last, with a little over 100 tons.

THE DAVY-FARADAY RESEARCH LABORATORY.—The most important contribution to chemistry during the last few weeks has been made by Dr. Ludwig Mond, whose name is already so well known in connection with the ammonia-soda process and with nickel carbonyl. Mr. Mond's latest contribution to science is the large freehold house, No. 20, Albemarle-street, next to the Royal Institution, and formerly the residence of the Earl of Albemarle; this he has bought and conveyed, in fee simple, to the Royal Institution for the purposes of a laboratory for physical and chemical research. Mr. Mond has also promised to clear all the expenses of converting the house into a laboratory and equipping with necessary apparatus and materials for research work; nor is this all: he will further endow it with an income sufficient to pay all local rates and such expenses, and with a sum sufficient to pay the salaries of some trained scientific assistants. The laboratory is to be called, by Mr. Mond's wish, "The Davy-Faraday Research Laboratory of the Royal Institution." Its establishment will realise an idea which was considered by Faraday, Brande, and the managers of the Institution half a century ago. It is, indeed, a noble endowment by a successful man of business and man of science, and that it will be productive of good to science there can be no doubt. Mr. Mond hopes that others will come forward and supply the means for "the foundation of scholarships and bursaries to qualified persons willing to devote themselves to scientific work and not in a position to do so without assistance." Thus will England at last have an endowed physical and chemical laboratory, endowed not by Government nor even by an Englishman by birth, but by a wide-hearted man who has already conferred benefits on English science and English industry. — *The Athenæum*.

Journal of the Society of Arts.

No. 2,180. VOL. XLII.

FRIDAY, AUGUST 31, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Proceedings of the Society.

CANTOR LECTURES.

THE DETECTION AND ESTIMATION OF SMALL QUANTITIES OF INFLAMMABLE GAS OR VAPOUR IN THE AIR.

BY FRANK CLOWES, D.Sc.Lond., F.I.C.,

Professor of Chemistry in the University College,
Nottingham.

Lecture II.—Delivered January 29.

It has been explained how the miner at first attempted to detect, and ultimately to measure, gas in the air of the coal-mine by means of the flame which he used for lighting purposes. The testing thus effected by flame-cap or by spiring, even when made with the best forms of lighting safety-lamps, is inadequate to detect small proportions of gas. Testing made by these lamps passes unnoticed per-centages of gas which must not only be detected, but measured, in order to avoid danger in an atmosphere charged with fine coal-dust, and in order to properly regulate and distribute the ventilating current of the coal-mine. The most successful lighting and testing lamp of this description appears to be the benzoline lamp of Mr. James Ashworth. This lamp, however, cannot be considered to give measurements of gas with any certainty under ordinary conditions, when the gas is present in quantity less than 1 per cent.

There is no doubt, however, that the flame-test for the detection and measurement of gas, is by far the most convenient method for general application, and, further, that it may be made to equal, if not to surpass in delicacy and accuracy, any of the methods depending upon other principles which have up to the present time been suggested.

In a general review of the accredited methods of gas-testing, it will be convenient to consider these rival methods of gas-testing before proceeding to describe the more recent improvements in the flame-test which deservedly cause it to remain in favour both on the score of accuracy and of convenience.

METHODS OF GAS-TESTING OTHER THAN THE FLAME-TEST.

Ansell's Diffusion Apparatus.—An apparatus was devised by Ansell, which depended upon the difference in the rate at which gases, which differ in density from air, spontaneously mingle with air. As is well known, this process of spontaneous mixture or "diffusion" of gases is a mutual one, each gas penetrating into or mingling with the other. Air, when it is mingled with the light firedamp, becomes lighter than ordinary air. Such a mixture, therefore, possesses the power of diffusing into air at a greater rate than the air diffuses back into it. Accordingly, if the process of "diffusion" takes place through a material of finely porous structure into a closed vessel of air, the pressure of the air within the vessel will necessarily rise. Ansell attempted to utilise this fact, and to devise on this principle a small and portable apparatus which would indicate and measure firedamp. The form ultimately adopted was a pocket aneroid barometer, the chamber of which was closed at the back by a plate of unglazed or "biscuit" earthenware. This plate was sufficiently porous to permit the diffusion process between the air inside the aneroid and the external atmosphere to occur, whilst it prevented the entrance or escape of air by mere mechanical pressure. The porous plate of the aneroid was protected by a brass cover until the time at which the test was to be made. On the removal of this cover, the diffusion process commenced, and led to an increase of pressure inside the aneroid, if the external atmosphere was of less density than the air inclosed within the apparatus. This increase of pressure was recorded by the aneroid, and was considered to be an indication of the quantity of firedamp in the air.

It is claimed for this apparatus that it also serves for indicating and measuring carbonic acid, or "choke-damp," in air. When this gas is mingled with air, it raises the density of the air. Accordingly, the presence of carbonic acid produces a decrease of pressure within the aneroid, and this is indicated by a movement of the aneroid indicator along the scale

in a direction opposite to that which indicates "firedamp."

The opposite effects produced by firedamp and by carbonic acid upon this indicator are one main cause of its indications being untrustworthy under the ordinary conditions of the mine. In all mines there are various sources of carbonic acid gas present. This gas mingles with the air spontaneously, and is also mixed with the air by the ventilating current, and by other mechanical means. Its presence in the air of the mine tends to counteract the effect produced upon the Ansell indicator by the presence of firedamp; and the indication which should be produced by the firedamp present in the air may thus not only be reduced, but may be neutralised, and even reversed.

Air containing 6 per cent. of firedamp is explosive, when fired from below. The admixture of as much as 15 per cent. of carbonic acid with this explosive mixture does not prevent it from being explosive. Yet this latter mixture would, when tested by the indicator, show only the presence of carbonic acid, and no firedamp would be detected. Air containing 8 per cent. of firedamp and 8 per cent. of carbonic acid is violently explosive, when it is fired; no firedamp would be found by the indicator in such a mixture.

Whilst the presence of carbonic acid tends to mask the indications produced by firedamp upon this indicator; water vapour, being of less density than air, tends, on the other hand, to magnify those indications. Changes of temperature, which must also affect the density of the air, are a further cause of disturbance; while changes of atmospheric pressure must also be carefully allowed for, if the readings are to be of any value. It is also found that when the apparatus is in constant use in the mine, the porous plate becomes clogged with fine dust, and thus prevents diffusion.

After pointing out these numerous sources of serious disturbance to the indications of this apparatus, when it is used in the mine, it seems scarcely worth while to add that the indications themselves are too small in amount to enable traces of gas to be found, since the presence of 1 per cent. of firedamp in the air produces a pressure record in the apparatus equal to only 0.0086 inch of mercury. It will therefore be seen that the apparatus is not only wanting in accuracy, but also in delicacy, when it is used in the coal-mine, and that it is untrustworthy and therefore apt

to seriously mislead if its indications are relied upon.

This short description and criticism of the Ansell indicator would have been unnecessary, if its trustworthiness and delicacy were not still relied upon by some of those who are inclined to employ it on account of its convenience.

Forbes's Dampscope measures the length of the air-column which is necessary to produce acoustic resonance to a musical note of standard pitch. Since the length of this column is dependent upon the density of the air, an experiment made upon the air of the mine gives a means of calculating its density. The indicator therefore furnishes the same information as the Ansell aneroid, and the indication of gas which it furnishes is subject to the same sources of disturbance and error. Attempts have been made to apply corrections, by which a more or less correct estimation shall be possible, but it will be seen that the record of firedamp is not direct and immediate.

Angus Smith's Air-compression Syringe was suggested as a means of indicating the presence of gas in the air, by the appearance of a flash on suddenly compressing the air in a strong glass tube. On forcing down a tightly-fitting piston by the hand, the heat generated by compression was found competent to produce the kindling of the gas within the tube, when not less than 5 per cent. was present. If spongy platinum is introduced into the tube a flash may be produced in air containing only 3 per cent. of gas. This method of testing has never come into general use. It has little to recommend it, since it is not more delicate than the ordinary Davy-lamp test, it does not afford any fair measure of the proportion of gas, and it is not free from danger of firing gas in the mine.

The Pitkin Indicator depends upon the principle of comparing the temperature of the air as indicated by a thermometer with a naked bulb, with the temperature shown by a thermometer whose bulb is coated with platinum-black. Both thermometers are exposed side by side to the air of the mine. The platinum-black covering the bulb causes a slow combustion of any firedamp present in the air to take place. This causes a rise in temperature to be registered by the thermometer with the covered bulb, and the rise of tempera-

ture thus noticed, or the difference between the temperature readings of the two thermometers, will increase as the proportion of gas present in the air increases.

This apparatus depends upon the maintenance in unchanged efficiency of the spongy platinum, and unfortunately this substance undergoes rapid deterioration by absorption of moisture and by the deposition of dust upon its surface. The method of testing is therefore not competent to give standard results. It is also very doubtful whether the apparatus is free from danger, since the platinum may reach a red-heat in the presence of a high per-centage of gas, and cause it to fire or explode.

Living's Electrical Indicator. — This apparatus is commonly known as an electrical indicator. It is electrical only in the sense that an electrical current is used as a convenient source of heat. The indications are dependent upon the elevation of temperature produced by the combustion of any firedamp present in the air. Instead of registering thermometrically the elevation of temperature, however, as is done by the Pitkin indicator, this apparatus records the increase of illuminating power which results from the higher temperature.

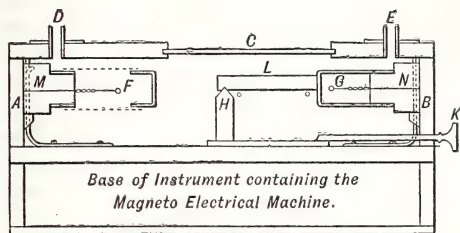
In its original form the indicator consists of a small magneto-electric apparatus inclosed in a box. By turning a handle on the outside of the box an electrical current is produced from the apparatus, and this passes through two precisely similar platinum wire spirals, heating them to dull redness.

These wires shine with precisely equally brightness when both are exposed to gas-free air. If, however, one of them is exposed to gas-free air and the other to air containing firedamp, the heat produced by the combustion of the firedamp upon the surface of the wire causes this spiral to glow more brightly than the other one.

This difference in brilliancy is easily visible to the eye, even when only a small quantity of gas is present. But to increase the precision with which the difference in brilliancy of the wires is noted and measured, the wires are made to illuminate the opposite sloping surfaces of a block, H (Fig. 1), which can be moved by the rod, K, along the graduated scale, L, until the illumination of the surfaces are equal. The position of H upon the scale then indicates at once the per-centage of gas present in the air. The adjustment of the block, H, is made, and the scale is read, by looking

through a glazed opening, C. The space in which the spirals and the recording apparatus are inclosed is filled with the air which is to be tested by means of the two openings, D E, the air being most conveniently drawn through this space by suction from the mouth. The air at once reaches the spiral, F, through the wire-gauze which surrounds it, whilst the

FIG. 1.



spiral, G, is inclosed in a metal tube containing gas-free air, and is, therefore, never reached by the gas. The light emitted by the spirals passes through glass plates, which close the wire-gauze tube, M, and the metal tube, N, and thus reaches the photometric apparatus. The indicator is shown in use in the mine in Fig. 2.

FIG. 2.



It is claimed for this indicator that it detects firedamp and measures its quantity accurately when the gas is present in percentages ranging from 0.25 upwards, and the satisfaction with which the indicator has been employed for a time in many coal-mines vouches for the accuracy and delicacy of the principle upon which it rests. Dissatisfaction

has, however, been expressed with its weight, and with the fact that it furnishes no light, and must, therefore, always be carried together with a safety-lamp which is required for lighting purposes. Considerable difficulty has also been experienced in obtaining, by means of the magneto-electric apparatus, a current of sufficient steadiness and constancy to furnish satisfactory readings. The current is also sometimes produced of such intensity that the exposed platinum spiral becomes fused and rendered useless. This is particularly likely to occur when much gas is present, and causes the wire to glow brightly. The replacement of a spiral thus rendered useless has hitherto been attended with serious delays. Complaints are therefore not unnaturally made of the inconvenient method of generating the current, and of the unsatisfactory nature of the current which is produced.

It has been further pointed out that as an indicator, to be used independently of other indicators, it would leave one in serious doubt as to the per-centage of gas actually present. The maximum indication which can be given by the instrument will evidently be diminished by the addition to the gaseous mixture which produces it either of more air or of more firedamp. Hence when lower readings are obtained on the scale, which would naturally be taken as a proof that less firedamp was present, these readings might be due to an increase, and not to a decrease, in the proportion of firedamp present, and might really be caused by a dangerous deterioration, and not by an improvement of the atmosphere. If used, as is commonly the case, conjointly with a safety-lamp, deception of this kind could not, however, easily arise.

Mr. James Grundy has, however, recently pointed out a source of inaccuracy, which is far more serious because it cannot at present be avoided. He has shown that while for several successive tests the indications of the apparatus, both for high and for low per-centages, are all that can be desired, the indications soon begin to alter materially, since the wire spiral, which is exposed to the gas, after being used for a time, undergoes a marked change in its electrical resistance. This necessitates the zero of the scale being set afresh in air free from gas; and such air cannot always be easily obtained underground. In some cases this change was so considerable, even during one round of testing in the coal-mine, that the scale could not be readjusted truly to the zero

mark at all, even in fresh air. This change in the wire cannot be foreseen with certainty; it is also difficult or impossible of correction, as has been stated, and the possibility of its occurrence leaves one in a condition of uncertainty as to value of a test when it has been made.

Apparatus, depending upon the change of pressure caused by burning the gas present in an inclosed volume of air, has been described by several inventors. The complete combustion of the firedamp present in the air would produce a decrease in volume approximately equal to twice that of the firedamp present. This decrease of volume might be measured as such, but it is usually indicated by the decrease of pressure it causes in a closed vessel, connected with a suitable gauge.

The names of Maurice, Coquillon, and Le Chatelier are associated with forms of apparatus depending upon the above principle. In all these forms of apparatus the firedamp, which is present in the sample of air contained in the closed vessel, is burnt by maintaining a metal wire at a red-heat in the air for about 30 seconds. The incandescence of the wire is produced by the passage of an electric current. In the Coquillon apparatus the indications are rendered inaccurate by the exposure of the air containing the products of combustion to water. The carbonic acid produced by the combustion of the firedamp is soluble in this liquid, and may be more or less completely dissolved, according to the proportion present, and the exposure to water which it suffers. This introduces an uncertainty in the results.

Le Chatelier avoids this source of error by substituting mercury for water. He also hastens the process of measurement, by surrounding the test-vessels with a water-jacket, which quickly cools the heated products of combustion, and therefore lessens the interval of waiting before the true pressure-readings can be taken. The tests made with this apparatus appear to be of a satisfactory nature, and the apparatus is an improvement on those of Maurice and of Coquillon. The presence of 1 per cent. of gas is indicated by a change of pressure, amounting to 0.5 inch of mercury.

It must be remembered, however, that these forms of apparatus are all of such a nature as to be suited rather for laboratory use than for use underground. They have to be carried, together with a safety-lamp, and with an

apparatus for producing an electric current, and on account of their fragile character and the ease with which they may be put out of order in the coal mine, they would naturally give way to more simple and portable apparatus which gives equally satisfactory results, when the tests are to be carried out in the pit itself.

Other forms of apparatus ascertain the amount of inflammable gas or of air, which must be added to the air containing firedamp, in order to bring the sample to the condition in which it just fires in contact with a flame. Manifestly, the volume of inflammable gas which must be added to mine air, will be less in proportion as the quantity of firedamp already present is larger.

The simplest form of apparatus devised for this purpose is the eudiometer of Le Chatelier.



FIG. 3.

It consists of a glass tube open at its larger end (Fig. 3), the upper part of which is narrow and is divided by graduations, each of which marks 1,000th part of the capacity of the tube when filled to a mark near its larger end. If the sample of air to be tested is not inflammable, the tube is filled with water, and inflammable gas is passed up, the number of graduations which it fills in the tube being read off. The tube

is then filled to the standard mark with the air under examination. The mouth of the tube is closed with the thumb, and the tube is removed from the water. Its gaseous contents are then well mixed by being shaken up with the water in the tube, and a light is brought to the mouth of the tube in a darkened room. If the mixture kindles, the test must be repeated with the admixture of a known smaller proportion of inflammable gas. These experiments are repeated until a minimum addition of the gas necessary to produce kindling by flame has been reached. This minimum volume having been ascertained, a simple mathematical formula gives the proportion of firedamp originally present in the sample of air.

If the sample of air to be tested is already inflammable, a similar procedure is adopted, but in this case the addition of air must be substituted for that of inflammable gas. It has been recommended to use coal-gas instead of firedamp in adding inflammable gas, as a matter of convenience.

This apparatus is said to have given satis-

factory results. It is manifestly slow in yielding a measurement of gas. The results are of doubtful accuracy if coal-gas of variable composition is employed, instead of methane, whilst the process becomes troublesome if pure methane is prepared instead. The apparatus may be suitable for use in a darkened laboratory on the surface; it certainly is altogether unsuitable for yielding prompt tests in the coal-mine: the use of the naked flame alone would condemn it as unsafe. Where samples of air can be transported and tested it might be adopted, but this is scarcely the requirement of the present day.

Shaw's Indicator proceeds on precisely the same principle as the above apparatus. By ingeniously - arranged mechanical means, a stream of the air which is to be tested is thoroughly mingled with a known proportion either of inflammable gas or of air, and is then passed over a flame. The proportions in which this mixture is made can be varied at will, and can be maintained unchanged as long as may be desired. The proportions are adjusted until the mixture is just brought to the lowest limit of kindling at the flame. The kindling is indicated automatically by the apparatus by the sounding of a bell. The lowest kindling proportion of the inflammable gas which is to be measured when mixed with air is first determined. The operator is then in a position, after reading off the proportion in which he has actually mingled his test-sample with additional air or gas, to calculate the proportion of this gas present in the sample which he is testing.

The apparatus, when working in its normal condition, appears to give indications of considerable accuracy and delicacy. It is credited with detecting and measuring firedamp down to the lower limit of 0.1 per cent.

It must, however, be understood that the apparatus is large and heavy and is wholly unsuited to be taken underground. The samples of air to be tested must be brought to it. This collection, storage, and transport of large samples of air is attended with much inconvenience and delay, and with risk of the sample undergoing change of composition before being subjected to the test. The apparatus itself also is of complicated construction, and must require constant attention to maintain it in normal and satisfactory condition. Further, the apparatus is very costly, and its nature necessitates its price being high.

These various objections to the general use

of the Shaw indicator would have less weight if other cheap and equally accurate and delicate forms of indicator did not exist. Other indicators, however, are now in use, which can be applied to testing samples of air brought from the pit. These have, moreover, the great advantage of being simple in use and easily portable, so that they can be applied to test for the gas in the pit itself. They accordingly give an immediate record of the proportion of gas present on the spot, without incurring any delay or risk of change in composition, such as is involved in collecting samples and transporting them to a laboratory on the surface of the ground. These simpler forms of apparatus also dispense with the troublesome necessity of maintaining a supply of methane gas, and with the uncertainty of the indications necessarily resulting from the substitution for methane of coal-gas of variable composition.

It will be seen, from this brief review of forms of gas-testing apparatus, which are not flame-tests, that some are practically laboratory methods only, and cannot be carried out, with convenience and safety, in the mine itself; whilst others are inconvenient, and others, again, give indications, which are open to doubt, or are entirely untrustworthy.

Flame-tests have, on the other hand, now undergone a satisfactory development, which renders them applicable in cheap and convenient forms of apparatus. These can now be employed in the mine itself with safety, and can furnish indications, which are at least equal in accuracy and delicacy to those furnished by the most trustworthy forms of apparatus already referred to.

Miscellaneous.

BRITISH FORESTRY.

The following letter to the Editor of *The Times*, signed "A Botanist," carries on the discussion on the important question of the condition of British Forestry, discussed by Prof. Balfour in his address as President of the Biological Section of the British Association (see *ante*, p. 788).

"Sir,—The address of Professor J. B. Balfour at the Oxford meeting of the British Association has scarcely received the attention it deserved. The subject of forestry generally has both a local and a general interest to Englishmen. It has a local interest, inasmuch as we are annually paying foreigners some 18 millions sterling for forest pro-

duce, much of which might, with advantage, be produced at home. It has a general interest, inasmuch as a timber famine would be felt as severely by Great Britain as by any country in the world.

"Experts have long seen the importance of this question, but there has been little, if any, development of public opinion; and, as Professor Balfour said, botanists have not sufficiently directed their attention to the encouragement of planting and the instructing of practical men in the scientific care of forests. In the United Kingdom there was more planting zeal of an enlightened character at the close of the last and the beginning of this century than there has been since. In many parts of the world the destruction of forests, without fresh afforestation, has been immense during the latter half of the present century; while it is probable that in no considerable country has the area freshly afforested very much exceeded that over which the forests have been cut down. A great part of the timber supply of the last half-century has been derived from the clearing—not merely the cutting down—of forests. Such areas are not now producing timber for future consumption. This work of forest destruction has been going on, not only in lands that have been newly colonised, and where the clearing of a great part of the land is a necessity, but also in Russia and other European areas which have hitherto sent large supplies into the world's timber markets. There has been, and is still, much careless destruction of forests over areas where a scientific arboriculture would have insured a reafforestation and a constant supply of timber in the future. Persons who form their opinion upon the subject from the present cheapness of timber, fail to take into account the fact that the demand for timber inevitably induces the irresponsible owners of forest land, especially in newly-colonised countries, to rush their timber into the market without regard to the consequences that must result from a wholesale and permanent destruction of forests. Unless the Governments of the world interfere much more than they are now doing to prevent it, irresponsible private owners will go on thus filling the market with timber, without providing for future supplies, until suddenly the supplies are stopped because no more timber exists. Not only do trees take many years to grow into timber, but when forests are once destroyed it is not easy—in some cases it is impossible—to reproduce them. The southern and eastern seaboard of the Mediterranean have been converted into arid wastes by the destruction of forests by the ancients. The northern seaboard of the same sea has also, in many places, suffered from the same cause. Were the areas of existing forests in North America, Russia, and elsewhere to become disforested, such fresh climatic conditions would be set up as would both be disastrous to those countries and would make the work of reforesting practically impossible, except at an exceedingly slow rate.

"That the threat of a timber famine within a measureable distance of time is no idle one can be

easily proved by a few figures. If the forest area of Europe and the United States be taken at 140,000,000 acres, and the annual consumption of timber of all kinds clears the timber off 23,000,000 acres, the whole would be used up in two generations, unless an equal quantity was being continually reproduced; but at present nothing like an equal quantity is being reproduced. This calculation has not taken into account the supplies from the forests of India and Australasia nor the untouched resources of Siberia. But the Australasian forests are rapidly disappearing before the axe of the colonist and the careless lumberman, and the development of the Indian and Siberian supplies will be largely used up in the constantly-increasing demand for timber all over the world. It may be imagined that the use of iron and other substances in the place of timber has diminished our need of timber, but it is not so. The United Kingdom now consumes five times as much timber as it did a century ago, and the difference is not due solely to the increase of the population, for the per-centage per individual has nearly doubled. Thus, what with the clearing of forests for the purposes of colonisation, the reckless and unnecessary destruction of forests where the land is not wanted for agriculture, the ever-growing consumption of timber, and the neglect in many countries of securing any adequate reproduction of timber, the relation between the demand and the supply of timber is yearly becoming more critical.

"So far, the only thing considered has been the bare supply of timber, but there are other and very important questions connected with the preservation of forests. Many districts, without their forests—or, at any rate, without some considerable areas of forest land—would become arid, uninhabitable wastes. In France the reafforesting of the hill-sides has in many parts been found necessary, to protect the surrounding districts from drought, on the one hand, and floods on the other. One important office in nature performed by masses of trees is that of holding the balance between drought and floods, but to enlarge upon these points would be to go too far into the technical details of forestry for our purpose here.

"Something must be said as to the domestic interest which the inhabitants of the United Kingdom have in the subject of forestry. There is, first, the question of having to buy of the foreigner what we might, to our advantage, produce at home. No country is better adapted to tree-growing than the British Isles. If left to themselves for a couple of generations they would again be what they once were, lands of dense forest. There are considerable areas now under arable culture which do not pay for their cultivation. They were forced into cultivation in the beginning of the century and at various times since by the temporary high prices of agricultural produce. Those high prices are, and will remain, things of the past. The world has become one great farm, and no fiscal regulations can for any length of time prevent the

free interchange of produce between the nations. It will be a century or more before the populations of the new countries consume the whole of their agricultural produce. Until then the agricultural value of poor lands in England must be low. The best thing to do with such lands is to plant them. Several collateral advantages would be obtained were this done. At present the modern system of draining agricultural lands carries off the rainwater only too rapidly, producing excessive flooding of the lower levels, and an unnecessary drought on the higher levels in such seasons as marked last summer. Woods act as sponges, retaining the rains and allowing the water to permeate the soil and fill the springs instead of rapidly flowing off, while the roots of the trees act as so many subsoil drains. Woods, judiciously planted, would also screen the adjoining areas.

"The great difficulty, of course, is to be found in the fact that planting is for many years almost unremunerative. As is often said, a man plants for his heirs. But we are the heirs of former planters, and should have been in a poor plight if our ancestors had cultivated only those crops that were immediately remunerative. Moreover, nature has now no room to plant for us, as she had in the past. This financial difficulty makes it necessary to call in either State aid or to adopt an extensive system of co-operation among landowners. As Prof. Balfour said, the State can do something by way of example on its own lands. This example would stimulate private planters, but such stimulation would scarcely be sufficient to effect all that is desired. Some system of State loans, repayable as the woodlands become remunerative, could be adopted. Certain kinds of planting would very soon give a return. Osier-growing is remunerative in two or three years. We import an enormous and ever-increasing quantity of osiers, most of which we could grow at home on land otherwise of little use. The growth of the fruit culture has largely increased the demand for baskets, and other industries are doing the same. In the case of the timber woods, some return would be obtained in the course of a few years, and local industries would spring up near the larger tracts of woodland, utilising the thinnings, &c.

"It is indispensable that the planting be undertaken under skilled superintendence, and that a sufficient body of trained foresters be obtainable. Forestry ought to take the place in English education which it takes in France and Germany, and ought also to have its prizes to attract a high class of students. We should do for home forestry what we are doing for Indian forestry. But before all this is likely to take place a well-informed public opinion must be created."

SERICULTURE IN SPAIN.

Consul Finn says that it is a matter of surprise to many that Malaga, whose climate and soil are

so peculiarly adapted to it, should have so entirely allowed the silk-growing industry to fall into oblivion. Up to fifty years ago, a very extensive and profitable business was carried on in that district in the various branches of sericulture and the manufacture of silken stuffs, but then the Lyons weavers took to adulterating or mixing cotton and wool with their silk, and thus producing a cheaper material and underselling those of the Spanish manufacturer, who, in course of time, was driven entirely out of the market, and even mulberry trees have now become comparatively rare in the province. In the province of Murcia, however, silkworm culture is carried on to some extent, and considerable attention is devoted to it. About 450 tons of silk were produced during the year 1893, and about 6 tons of fishing gut, being a little in excess of the quantity produced in 1892. The native silkworm seed, which is considered the best, is of a pale yellow colour, and is known in the province of Murcia as "Antrado." One ounce of this seed will produce from 100 to 125 lbs. of silk. The price of this seed is about 20 to 25 pesetas (peseta = 9 $\frac{1}{10}$ d.) per ounce, according to the quantity in hand. The seed is either put out in the sun, or is put into the beds of the people who rear them, during the first week in March; if the weather is favourable, the silkworm will be hatched within seven days. They are placed upon sheets spread upon large trays made of cane; they are then put out into the sun during the day and brought indoors at night. They are then fed on mulberry leaves for from six to seven days, when the worm sleeps for two days, changes its skin a second time, and this is repeated thrice. After the third sleep, the worm feeds for seven or eight days, and then begins to spin on bunches of esparto grass placed for that purpose. On the eighth day after the worm has begun to spin, the cocoon is taken down and either sold at once or, if prices do not suit, the cocoon is placed in a slow oven and the worm is smothered. The cocoon can then be kept until prices are suitable. Each ounce of silkworm seed is calculated to eat 2,600 pounds of mulberry leaf. If the silkworm is intended for fishing gut, the larger worms are selected, on leaving the feeding trays to spin. They are put into vinegar, salt, and water, the strength of which liquid is tested until a fresh laid egg will float in it. The worms are left in this liquid over night and early next morning are drawn out, by taking hold of the head and tail and using a little force. They are then put into clean water and washed, and after being well cleaned with chamois leather, are dried in the sun. Each worm yields two pieces of gut. Women are employed in this operation, and are given two pesetas and their food per day. When seed for the coming year is desired, a few cocoons are left where the worm has spun them, and on the fifteenth day after beginning to spin, a moth is produced which deposits its eggs on a cloth placed there for that purpose, and then dies. The cloth and seed are then put away until the coming year.

BORDEAUX EXHIBITION.

Referring to the notices of the Exhibition, to be held at Bordeaux in 1875, by the Bordeaux Philomathic Society (see *ante*, pp. 740, 758), further information has been received from the Foreign-office, through the Science and Art Department, in the form of a list of articles that will be exhibited:—

Articles of British Production, Manufacture, or Trade, &c., which will be received at the Bordeaux Exhibition, 1895.

1. Animal products, including sheeps' wool, hair, lard, bacon and hams, fish oils (Group 8).
2. Farinaceous food, including ship biscuits, dog biscuits, poultry food, oatmeal, rice, vegetable flour (Group 20).
3. Fruit and grain, including preserved olives, gherkins, capers, &c., grass seed (Group 20).
4. Groceries, including jams, biscuits (sweet), molasses (for distilleries), cocoas, teas, coffees (Group 20).
5. Oils and vegetable extracts, including palm oil, linseed oil, cotton seed oil, gutta-percha and india-rubber (Group 20).
6. Woods (exotic) (Group 9).
7. Vegetable fibres, including cotton (raw), jute (raw), phormium tenax (Group 23).
8. Colouring extracts, including gall-nut extract (Group 20).
9. Miscellaneous raw produce, including bran of all kinds (Group 11).
10. Liquors of all kinds, including wines (Group 14); spirits (rum, &c.), (Group 15); beer (Group 16).
11. Mineral products (natural), including kaolin (porcelain clay) natural phosphates, talc, sulphur (sublimated), coal, mineral tar, bitumen, petroleum and paraffin (Group 17).
12. Metallurgical products, including cast iron, cast steel, copper (bars and plates), tin (bars and plates) (Group 19).
13. Chemical products, including oxalic acid, oxide of lead, oxide of iron, carbonate of potassium, bicarbonate of soda, caustic soda, carbonate of magnesia, sulphate of ammonia, sulphate of copper, sulphate of iron, sulphate of aluminium, chromate of potassium, chromate of soda, superphosphate of lime and other chemical manures, sulphuretted carbon, products of coal distillery (Group 19).
14. Dyes and colouring matter, including varnish, ochre (Group 19).
15. Soap and soap shavings, mustard, starch, candles (Group 9).
16. China, crockery and glass, including fireproof (common) pottery, crockery and stoneware, porcelain, table glass, tiles (Group 22).
17. Threads and yarns, &c., including yarns of hemp, flax, and cotton, yarns of goat and camel hair (Group 23).
18. Tissues, including oilcloth and linoleum, jute

manufactures (sacks, &c.), cotton (white, dyed, printed), wool (cloth, carpets, lastings, hosiery), alpaca cloth (Group 23).

19. Paper, including writing paper, wall-paper, photographic paper, cardboard (Group 3).

20. Skins, furs, leather, &c., including sheep and lamb skins, leather and leather manufacture (Group 10).

21. Jewellery, plate, and plated goods, &c., including silver-plated ware, electro-plate, Britannia metal ware (Group 4).

22. Machinery, engines, &c., including hydraulic engines, gas engines, agricultural machinery, milling machinery, sewing machines (Group 18), velocipedes—bicycles (Group 24), machine tools, weighing scales (Group 18).

23. Iron ware, including hardware (cutlery), stoves and grates, iron pipes (Group 18), garden tools, iron bedsteads (Group 22).

24. Furniture and wooden manufactures, including household furniture, wooden toys, and household utensils (Group 22).

25. Indiarubber goods, including indiarubber clothing, shoes, &c., indiarubber tubes, belting, (Group 23).

26. Felt carpetings (Group 23).

27. Hats of felt, silk, and other materials (Group 23).

28. Umbrellas and sunshades of all materials (Group 23).

29. Electrical machinery and apparatus of all kinds—telephones, &c. (Group 27).

30. Works of art (paintings) (Group 2).

31. Works of artistic industry (Groups 3 and 4).

CINCHONA CULTIVATION IN BRITISH INDIA.

In a recent report of the Indian Government, it is stated that on the Government plantation of the Darjeeling district in Bengal there were, at the end of the year 1892-93, 4,331,000 cinchona trees, or 100,000 less than in the preceding year. Of the existing trees, nearly four-fifths are of the pure quinine-yielding variety, and less than one-quarter belonging to the cinchonine-yielding variety. During the year 466,000 trees were uprooted for their bark, or died, while 184,000 were planted out; all the new plantations have for some years past consisted of quinine-yielding varieties. The harvest of dry bark was 304,000 lbs. The factory produced during the year 3,481 lbs. of cinchona febrifuge, and 5,242 lbs. of sulphate of quinine. Quinine is now sold to public institutions and Government offices at one rupee per ounce, while the febrifuge is sold at ten annas per ounce. The issues from the factory were 3,647 lbs. of febrifuge and 5,518 lbs of quinine. The sales and issues of medicine during the year yielded a profit, after meeting all charges for maintaining the plantations, renewing plant, and working

the factory. As soon as the remaining million of red bark trees are used up, it is intended to manufacture only quinine, and to cease making cinchona febrifuge at the Darjeeling factory. The capital cost of the plantation had been repaid by the sale of cinchona drugs in previous years. During the year 1892, 475 lbs. of quinine were put up in 5-grain doses; each dose is carefully packed, and bears simple instructions in one of the vernacular languages of Bengal. The packets are made up in the jail department, and they are issued to local postmasters, who, for a small commission, retail them to the public at one pice (one farthing) per packet, or dose. As yet, the arrangement has been made for Bengal only; when it is extended to the provinces, the demand for quinine thus brought in convenient shape, and in an absolutely pure state, to the doors of the people, is expected to increase indefinitely. Ample ground has been reserved for extending the Darjeeling plantations. In the Government plantations on the Nilgiri hills, in Madras, the cinchona trees are almost all of the quinine-yielding varieties. Drought, and the absence of sunshine, made the year 1893 unfavourable for cinchona cultivation on the Nilgiri hills. The stock of dry bark in hand at the beginning of the year was 416,000 lbs.; the harvest of the year was 119,000 lbs.; the consumption of the factory was 172,000 lbs.; and 2,000 lbs. were issued in the shape of bark. The produce of the factory during the year was 4,933 lbs. of quinine and 3,139 lbs. of cinchona febrifuge; 3,204 lbs. of the former and 2,600 lbs. of the latter were sold or issued to Government and municipal or local departments. The number of quinine powders issued to the public by collectors of districts rose to 170,000, from 37,000 in the previous year. The area under cinchona on private plantations outside Bengal is returned at 10,862 acres, nearly all of which are in Madras. The exportation of cinchona bark from India by sea, which was 3,074,000 lbs. in 1888-89, and 2,693,000 lbs. in 1891-92, rose to 2,814,000 lbs. in 1892-93.

THE WATERWORKS OF NAPLES.

H.M. Consul at Naples says that the supply of pure water conveyed to the city by the Naples Waterworks Company has been of such immense benefit to the sanitation of the city, that the manner in which this supply is obtained may be interesting to record. Since the opening of the works not only the needs of Naples has been regularly and abundantly provided, but the supply has been copious enough to furnish many of the adjoining communes and islands in the Gulf of Naples with good water, when such communes and islands were afflicted with epidemic diseases, arising from an insufficient and generally impure supply of drinking water. The supply comes from the springs of Urcinoli, in the

valley of Serino, about thirty miles nearly due east of Naples, and 1,080 feet above the level of the sea. It was originally proposed to utilise also the springs of Acquaro, situated in the same valley about 140 feet higher up, but on the first-mentioned springs being enclosed, it was found that in the driest season they furnished the amount stipulated for in the contract with the municipality, viz., a minimum of 37,000,000 gallons a day. The passage of water through the aqueduct is accordingly limited to 440 gallons a second. The consumption of Naples is calculated at 44 gallons a day per head (in comparison, it may be noted that the average consumption per head in London was given by the Royal Commission at 31 gallons per head), which, with a population of 50,000, only amounts to 22,000,000 gallons; consequently, at present, 16,000,000 gallons of water run to waste. In case, however, of still more water being required, the springs of Acquaro and Pelosi still remain untouched, and could be brought into requisition. The geological formation of the ground at the springs consists of an impermeable stratum at a depth of 40 feet; aqueous stratum 10 to 12 feet thick, composed of sand, shingle, and calcareous rock, covered and protected by a constant crust of black volcanic sandstone; and above this, vegetable earth and gravel. The subterranean waters are derived from distant parts of the mountainous region, by which the valley is surrounded. Two mountain torrents, which traverse the tract of land above described, have been floored and walled with concrete to prevent their currents from mingling with the springs. An area of 35,000 square yards to 40,000 square yards of the aqueous sand has been drained by means of three collecting channels, about 6 feet high and 5 feet wide, which have a total length of 563 yards. They are generally placed either in the tufa or at the top of the aqueous stratum. The bottoms of the conduits are made porous, and a considerable space outside the walls of each channel is packed with broken limestone. Over the whole are two layers of beaten clay, with a layer of cement between each, so that the surface water cannot penetrate the system. Above this, earth is filled in to the general level of the area. The water that flows into and through these channels is very pure, and of the average temperature of 12° Centigrade. The conveyance of this large quantity of water to Naples is effected as follows:—A covered masonry canal lined throughout with Grenoble cement, laid generally at a depth of three feet below the surface of the ground, but sometimes through tunnels under the hills, doubly placed along aqueducts raised 66 feet over valleys, and once changing into four parallel iron tubes, 2½ feet wide, which descend into the valley of Cronti, and rise on the opposite side, having, at the lowest point, to resist a pressure of seven atmospheres, conveys the water for a distance of 37 miles into two covered reservoirs on the hill of Cancellò, about 12½ miles distant from Naples. The reservoirs are at

the respective elevations of 68 and 444 feet. The power of the fall of water from Cancellò into the plain is calculated at 2,900 horse-power, and might be easily utilised for the production of electricity. From these reservoirs three iron syphons proceed down into the plain, and up into the hill of Capodimonte, which dominates Naples. The longest of the three syphons measures more than 14 miles from end to end; it debouches into the high-service reservoirs 600 feet above the sea-level. These reservoirs may be reckoned among the grandest works of modern times; they are entirely hewn out of the rock. The low-service one holds 240,000 cubic feet of water in five large tunnels, which are filled to a depth of 27 feet. This reservoir lies 150 feet below the surface of the ground, so that the water is always cool. From the Capodimonte reservoirs the main service pipes branch all over the city, forming a network, with close meshes; the supply is continuous, and there are no domestic cisterns. From this description it will be seen that the water is collected under ground, in pure mountainous strata, at a high elevation. All the reservoirs are subterranean, and the water therefore is never exposed to the open air until it issues from the taps or fountains in Naples. Reservoirs and aqueducts are alike thickly lined with Grenoble cement, rendering pollution impossible. The length of the whole system of pipes that feed the city from the reservoirs of Capodimonte was, at the opening of the works, 62 miles. Numerous public fountains stand in all the twelve quarters of the city, and flow constantly.

CULTIVATION AND USE OF LENTILS IN INDIA.

The lentil is a valuable pulse grown as a winter crop all over India, especially in the Central Provinces and Madras. In the Punjab it is commonly cultivated throughout the province, and is grown as high as 5,500 feet on the Chenab, and in parts of Laddack as high as 11,500 feet. The United States Consul at Calcutta says that in his district the lentil is an inundation crop, and is never sown on other soils; either new alluvial soils or light lands that are not good enough for wheat are selected. It may follow "mattar" (*Lathyrus sativa*) or be the first crop on new alluvial soil. The land is ploughed once or twice and the seed is sown broadcast. One ploughing takes place after the seed is sown. December and January are the months for sowing, from thirty to forty-five pounds of seed per acre being the quantity used. The crop ripens towards the end of March or the beginning of April. It is reaped, not pulled. The yield is light, and the pods are liable to be attacked by caterpillars. Rain, wind, and thunder are hurtful when the plant is in flower. In the North-West Provinces the lentil is grown as a winter crop, under much the same conditions as pease. It is grown on all kinds of soils, but chiefly in lowlands. It is seldom grown after an autumn fallow, but most

commonly follows early rice. It is often sown while the rice stalks are standing and allowed to grow up among them. Three ploughings as a rule are sufficient. The quantity of seed sown per acre varies with the condition of the soil, but is commonly about eighty pounds. The average product per acre on un-irrigated lands is from 520 to 640 pounds of grain, but with irrigation from 800 to 960 pounds would not be an excessive return. In the Central Provinces the lentil is everywhere grown as a cold weather crop. Its cultivation is largest in the Narbudda valley, the Satpura district, and Chattisgarh. In the Nagpur district it is less popular. The crop is generally on the best black soils. The growth of lentils on black soils may be accepted as an indication that the land is of the best quality. A curious fact in connection with its cultivation in Chattisgarh is that the Santami Chamaro, who form an important section of the agricultural community, decline to have anything to do with it, on the ground that, in its red colour, it resembles flesh. In Berar, the crop is grown only to a small extent. In Bengal, there are two varieties grown, the Patna variety, and a variety met with in Lower Bengal; the plants of the latter are bushy, and give a better yield; it thrives best on clay soils, as, in a very light soil, the plants wither away; it comes after and is followed by rice; three or four ploughings suffice. It should be sown when the land is fairly dry, for if too much moisture be present the plants shoot up quickly, but afterwards make no progress. Twenty pounds of seed are sown to the acre, from the middle of October to the end of November, and barley is sometimes mixed with it. It is harvested in February and March, and yields from 480 to 640 pounds per acre. In the Baghulpore district one or two ploughings and one or two harrowings are considered sufficient. The seed is sown in October and November, and the crop is reaped in March and April. Lentils are also grown, to a limited extent, in Chutia-Nagpur, and in the Behar districts. In Bombay the lentil crop is an unimportant one, compared with the other pulses; as in other districts, it is sown in October. It is chiefly grown in the area of Nasik; Assam and Burma also produce lentils. The lentil is especially suited to low-lying moist soils; the soil requires very little preliminary working, and the crop little attention; the yield might be considerably increased, if more pains were taken with the selection of seed for sowing, since there are some varieties of the lentil which produce seed weighing twice as much as the small, common sort, and which, notwithstanding their size, do not make a proportionately increased demand on the resources of the soil. The lentil is eaten by the natives as "dal," flavoured with various ingredients, and as a component part of the dish called "kichri." It is considered the most nutritious of the pulses; it is thought to be heating, when too freely indulged in, and to cause eruptions. The young pod is occasionally eaten as a vegetable, and the dry leaves and stalks are used as fodder for cattle,

MINING INDUSTRIES OF NORTH PORTUGAL.

There are good lodes of antimony running from north-west to south-east, about eight miles from Oporto; the principal mines are Montalto, Godomar, Tapada, and Vallongo. Consul Hay Newton says that these have been worked for some years with more or less success, large dividends having been paid on some of them, but as a rule they have been mis-managed. The antimony is found in the quartz reefs which intersect the silurian schists, but in the same quartz veins gold appears, sometimes in considerable quantities, but whether in paying proportion is still a problem to be solved by mining engineers. During the last eight or ten years attention has been attracted to the extraction of gold. Quartz, principally from the mines referred to above, has been sent to Germany, and also, it is stated, to England, and the percentage of gold extracted appears to be favourable, but the expense of shipping the quartz for extraction was so great that attention was turned to effecting that process on the spot. Great secrecy has been maintained with regard to the results, therefore no opinion can be formed as to whether the undertakings have been profitable or otherwise. In Portugal there are three distinct coal deposits. In the north, near Oporto, the coal is anthracite, of good quality, but often so mixed with shale as to render the working difficult. The principal mines are St. Pedro da Cora, Passal de Baisco, Covello and Midoës and Pejão. The coal extracted from these mines is used in Oporto for cooking ranges and stoves, and the soft coal is made into *briquettes*, or patent fuel, for the same purpose. Near Busaco, at Santa Catharina, there are some coal beds of a semi-bituminous coal, but these mines are not now being worked. The principal silver and lead mines are Braçal, Coimbra, and Gondarem, but the latter mine is not now working. A small amount of manganese is extracted and shipped abroad from a mine near Anadia. Iron is found distributed generally all over northern Portugal, in larger or smaller degrees. The only large deposit is at Moncorvo, about eighty miles up the River Douro. This iron is magnetic, and the supply is very large, but the distance from a sea port renders it valueless, until a railway or other means of communication enables it to be shipped at a small expense. A small amount of gold washing is done, but only in summer. There are several very good slate and marble quarries in northern Portugal. The latter, although the marble is of very fine quality, either from bad management or some other cause, do not seem to be worked with success. Slate, however, is worked in some districts most successfully. One quarry, near Vallongo, belonging to an English company, exports slabs, beds for billiard tables, and slates for roofing, both to England and Brazil. One slab, 17 feet long, from this quarry, was exhibited at the Adelaide Exhibition.

THE ECONOMIC CONDITION OF CHINA.

On the subject of the productive forces and natural wealth of China only a general idea is obtained from the reports of missionaries, travellers, consular, and diplomatic officers, and the representatives of trading houses there, the official returns being silent, except so far as regards the commerce of the country. In his dictionary of statistics, Mulhall gives some interesting particulars of trade, population, shipping, and coal mining, but he says nothing of agricultural and other industries. A correspondent of the *Economiste Française* says that the Chinese are essentially an agricultural and industrial people, but the country has to support the burden of a population of over 400,000,000 of souls. The country may be divided into two zones. The first, which may be called the mountainous zone, comprises seven provinces, with an extent of about 858,000 square miles, and a population of 101,000,000. This is a poor zone, into which travellers rarely venture. Rice, which is the staple commodity, cannot be cultivated in all parts of this zone, it being necessary to import it from other districts. It is this district which furnishes to China her soldiers, emigrants, and pirates; it is also what may be termed the revolutionary zone. It could be made, by cattle rearing, a source of considerable wealth, but the Chinese are the least of all nations devoted to pastoral pursuits; they do not possess many cattle, and consume very little milk; in general, their favourite articles of consumption are fish, pork, poultry, and particularly ducks, of these they possess an immense variety. The second zone—the great Chinese zone—is in the delta, or, rather, the series of deltas formed by the Hoang-Ho, Yang-Si-Kiang, and other less important streams. This zone comprises 11 provinces, with a population of 300,000,000. These provinces are the following:—Kouang-Toung, Fo-Kien, Tche-Kiang, Kiang-Si, Hou-nan, Kiang-son, Hou-pé, Ngan-Hoei, Ho-nan, Chang-Toung, and Pé-tchili. In this zone the provinces of Tche-Kiang, Hou-nan, and Kouang-Toung are not so densely populated as the others. In the north, particularly in the great plain which adjoins Peking, the cultivation of cereals abounds, such as rice, wheat, and millet. As regards rice, the country does not produce sufficient for her requirements, but has to resort to importation. Thus, in severe winters, she is exposed, more particularly in the provinces of the first zone, to terrible famines and distress, such as those experienced in 1878, as China is almost completely wanting in railways, and the only good routes belong to the second zone, notably the canal which places the river in communication with Pei-Ho, and Tien-tsin with Hang-Tcheou. The rich, tropical articles of cultivation, such as tea, hemp, silk, indigo, bamboo, &c., belong particularly to the southern provinces of the second zone. The best teas come from the maritime provinces of Fo-Kien and Kiang-sou. The Chinese are the finest horticulturists, gardeners, and silk growers in the world. They are wonderfully successful in fruit

growing. The Chinese are also great fish breeders, for fish replaces meat as an article of diet in China. As regards the production of silk and tea, it is estimated that the former, throughout the world, amounted, in 1890, to 25,000 tons, of which China contributed 11,000. As to tea, an idea may be formed from the figures of the exports; these fell from 133,000, in 1880, to 108,000 tons in 1893. As industrial production, China is the country of all others possessing the greatest number of small workshops and factories for working all kinds of metals, for the extraction of minerals, the manufacture of furniture, silk wares, porcelain, paper, looking-glasses, lacquer wares, articles of mother-of-pearl, tortoiseshell, and ivory; for the preparation of varnish, inks, colours, coarse woollen goods, &c. The Chinese make excellent workmen, and the Chinese factory is a model of the small workshop, in which the proprietor works with one or two apprentices. The Chinese territory is particularly rich in minerals of all kinds, particularly in coal and iron. The coal industry has a great future before it in this country, but at present its development is checked by the want of capital, engineers, and workmen. China with its dependencies, forming an area eight times as great as that of France, carries on a considerable internal trade by means of the chief rivers, their affluents, the old roads, and the canals. There is a constant interchange of commodities between the eighteen provinces and the dependencies. As regards the foreign trade of the country, Chinese commercial relations may be divided into two groups, first the relations with the neighbouring States, Japan, the Malay States, Indo-China, India, and Russia. These relations are of old standing and are maintained as much by land as by sea. The Chinese for a long time past have founded colonies round the mother country. Chinese are met with in all the islands of the Indian seas, and by reason of the extent of their capital, their intelligence and their relations with China itself are of considerable importance in the commercial community. Then come the relations with other nations, particularly with England, Germany, the United States, and France. These relations date principally from the latter part of the present century. Trade is carried on through the various Treaty ports, which are twenty-four in number. The total value of the imports for home consumption into China in 1893 amounted to £30,272,000, as compared with £29,413,000 in 1892, and £32,943,000 in 1891. The corresponding figures for the exports are £23,326,000, £22,333,000, and £24,816,000. In the imports, cotton, woollen, and metal goods take the first rank, while in the exports the principal articles are silk, sugar, and tea. The principal countries from which imports are received into China are in the order of their importance as follows—United Kingdom and its dependencies, Japan and the United States. The amount of import duties levied in 1893 was £1,240,000 as compared with £1,464,000 in 1892, and £1,760,000 in 1891.

Journal of the Society of Arts.

No. 2,181. VOL. XLII.

FRIDAY, SEPTEMBER 7, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Proceedings of the Society.

CANTOR LECTURES.

THE DETECTION AND ESTIMATION OF SMALL QUANTITIES OF INFLAMMABLE GAS OR VAPOUR IN THE AIR.

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Lecture III.—Delivered February 5.

THE FLAME-TEST.

The flame-test for detecting and measuring small proportions of inflammable gas and vapour in the air, possesses the following advantages over other methods which have been already referred to :—

1. The flame-test is not appreciably interfered with in its indications by the presence of carbonic acid, or of moisture, within the limits in which these occur in the coal-mine.
2. The variations of the pressure and temperature of the air of the mine which occur under working conditions do not appreciably affect the results.
3. The test can be made on the spot where the per-centage of gas in the air is to be found.
4. It yields its result at once, without the delay caused by a lengthened experimental process, or by the necessity of calculation or of correction.
5. The apparatus required for the test is simple in character, and cannot easily be put out of order; it is not fragile, and will stand the rough usage to which it may be necessarily subjected in the mine.

6. The method of testing requires no special training or explanation, since it is the one usually employed in the coal-mine. Further, no demand for skill or dexterity is made on the observer beyond that which may be expected of any mine official; and in the better forms of flame-testing apparatus only average eye sight is necessary to perceive and register the indications.

This test is applied by means of a suitable flame burning in some form of safety-lamp. It should undoubtedly be made by the flame-cap method, since the "spiring" of the flame is untrustworthy, for reasons which have been already stated.

IMPROVEMENTS IN THE METHODS OF FLAME-TESTS.

The very considerable advantages presented by the flame-test over other methods of gas-testing must be manifest; it has therefore been felt by many inventors to be a matter of great importance to improve the original simple, but insufficient apparatus by which the test was applied, and to make its indications as delicate and trustworthy as possible.

The principal defects in the Davy-lamp oil flame, which was the first safe method employed for detecting gas by means of the flame-cap, were the following :—

1. Owing to variations caused in the wick by charring, to the rapid changes suffered by the flame, and to the absence of any standard of adjustment, the flame cannot be always set to an invariable size; and since the appearance and dimensions of the flame-cap seen over any particular flame vary considerably with the dimensions of the flame, the flame-caps, seen at different places and at different times, are not comparable with one another or with any standard. In special tests with small percentages of gas, the variation reached 150 per cent. This defect applies, in varying degree, to all wick-fed flames.

2. The reduced oil flame is not sufficiently large and hot to yield visible caps, when small per-centages of gas are present. The flame is of necessity considerably reduced in size, in order that its luminosity may be, as far as possible, removed. Even in the presence of the slight luminosity of the reduced flame, the pale caps, given by small per-centages of gas, become invisible.

3. The obstruction offered by the gauze of the Davy-lamp prevents pale caps from being

detected, and the back-ground of the gauze is also not well adapted to throw up the cap.

MM. Mallard et Le Chatelier, in 1881, as has been already stated, remedied some of the defects of the oil-flame, as ordinarily applied. In the lamp introduced by these gentlemen, the reduced flame was concealed from the eye by metal screens (Fig. 1), and it could be

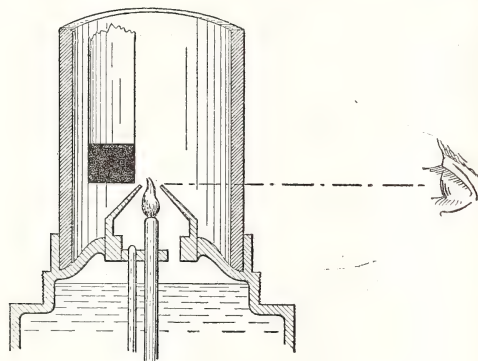


FIG. 1.

roughly brought to standard height, by drawing down the wick, until the tip of the flame just reached the upper edge of the screen. The cap was also observed through glass instead of through gauze, and was seen against a dead-black background eminently adapted to render it visible. This lamp accordingly enabled lower per-centages of gas to be detected than were discoverable by the Davy lamp. But it still possessed the disadvantage of employing a flame which could not be called strictly a standard flame, owing to the serious and rapid alterations which the oil wick undergoes in burning. The flame was also still too small to give distinct and easily visible caps in the presence of small proportions of gas. Complaint was also made that the flame lost much of its lighting power, when it was raised to its full height, by the obstruction offered by the screens.

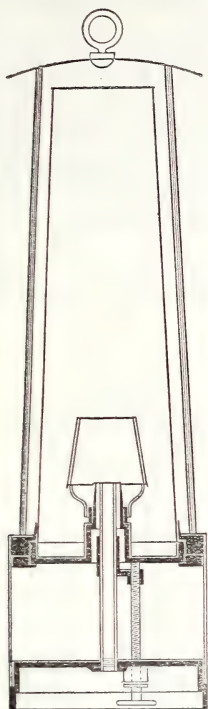
James Ashworth, working on somewhat the same plan, has also introduced a lamp which has already been referred to (*ante*, p. 796). This lamp burns benzoline, and this prevents the serious charring of the wick which occurs when oil is used. The reduced benzoline flame is decidedly superior to the oil-flame for testing purposes. It maintains itself more satisfactorily after having been adjusted, it possesses less luminosity, and when in use it is shielded from the eye by a screen, which also

serves for setting the flame to uniform height. The caps are observed through glass against a roughened non-reflective background; and although the caps are small, and with low proportions of gas are apt to be confounded with the halo always visible over the benzoline flame, they are undoubtedly visible when from 1 to 1.5 per cent. of gas or upwards is present.

MM. Mallard et Le Chatelier, in 1881, proposed another plan of increasing the delicacy and accuracy of the flame-test for gas. Recognising that one of the principal disadvantages hitherto attaching to this test arose from the necessity of employing a very small flame, reduced in size in order that it might not be luminous, they suggested the adoption of a flame which was non-luminous, even when it was of large dimensions. The flames which naturally occurred to them were those of alcohol and of hydrogen. They found that with a large alcohol flame 0.5 per cent. of firedamp could be detected, whilst a hydrogen flame enabled 0.25 per cent. of the gas to be readily found. These gentlemen proposed to burn the testing-flame in a separate safety-lamp, which would be carried together with the illuminating oil-lamp. Since the hydrogen flame proved itself to be superior to the alcohol flame, they attempted to devise a means for the chemical generation of hydrogen gas in the oil-reservoir of a safety-lamp, intending to burn this gas in a regulated stream from a jet fixed within the lamp and connected with the reservoir. This attempt ended in failure; the process of generating the gas was troublesome and unpractical, and the regulation of the size of the flame was found to be impossible.

Pieler, in 1883, described an arrangement by which a hydrogen flame of more or less standard dimensions might be produced from a chemical generator, and might be used above ground to test samples of gas brought up from the mine. This apparatus was not adapted to the ordinary necessities of gas-testing in the mine, and does not appear to have come into use. But, failing to adapt the hydrogen flame to an ordinary safety-lamp, Pieler devised a large gauze-lamp, similar in character to a Davy lamp, in which alcohol, instead of oil, was burnt from the reservoir by means of a circular wick. A large pale, but somewhat luminous, flame was thus obtained, which was concealed from the eye by being surrounded by a circular, conical metal screen

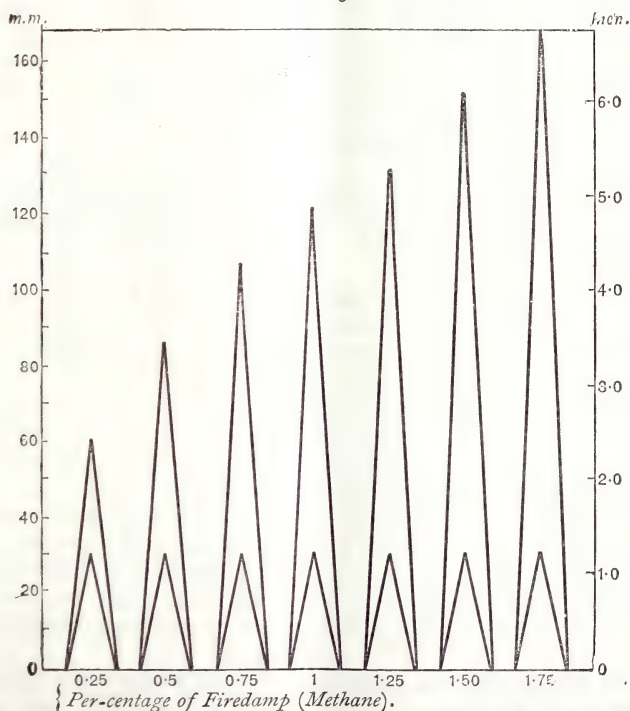
FIG. 2.



SECTION OF PIELER LAMP.

(see Fig. 2), and was set to standard height by bringing its top to a level with the top of the screen. The large flame of the Pieler lamp gives caps of much greater dimensions than those which are furnished by the ordinary flames employed for gas-testing (Fig. 3). The lamp in its original form was, however, far from being safe for use in the coal-mine. The flame of gas burning within the gauze could be blown through the gauze and make the gauze red-hot, and thus lead to firing of gas in the air around. This danger has been removed by "bonnetting" the lamp, or surrounding the gauze by a metal cylinder. The observation of the caps is made through a window in the bonnet, but the use of the window much impairs the visibility of the smaller and fainter caps. Another cause of trouble and danger arises from the heating of the alcohol reservoir by the combustion of gas within the gauze of the lamp. This causes the alcohol ultimately to boil, and leads to the production of a large and dangerous flame of burning alcohol vapour. This property of the lamp renders it impossible to take it into any part of the mine, where more than 2 or 3 per cent. of gas may be present. In any case, the lamp cannot be used in the mine without

FIG. 3.



PIELER FLAME AND CAP.

(Half actual size.)

being accompanied by an ordinary lighting safety-lamp, since the alcohol flame itself does not serve for illumination. The lighting-lamp, accordingly, is employed to test for the higher proportions of gas; and the Pieler lamp, which cannot indicate more than 1.75 per cent. of gas by the flame-cap, is employed only for the lower per-centages.

The Pieler lamp has been used in many mines, where the manager undertakes the wise, if not necessary, precaution of systematically examining the air for traces of gas. It is undoubtedly more delicate and accurate in its indications than the oil-lamp, but it falls, in many respects, short of the standard to be desired. Careful experiments undertaken with this lamp have shown that it possesses the following disadvantages.

1. Although arrangements are made to bring the alcohol flame to standard height, it is impossible to adjust the height with any certainty, since the tip of the flame is of a hazy and indefinite character. Any slight variation in the adjustment of the height of this large alcohol flame produces considerable effect upon the height of the flame-cap and the consequent measurement of the gas.

2. The hazy tip of the flame, as seen in gas-free air, corresponds almost precisely with the cap produced in the flame by the presence of 0.25 per cent. of gas: hence this proportion of gas cannot be detected and measured with any certainty. Thus, the following differences in cap-height were noted, with varied height of test-flame:—

Per-centage of gas.	Test-flame 10 m.m.	Test-flame 15 m.m.
1 per cent. of gas	27 m.m. cap.	50 m.m. cap.
0.5 " "	23 " "	38 " "

3. The serious obstruction offered by the gauze, and by the window in the bonnet when it is slightly soiled, prevent the fainter caps from being seen at all. This effect is increased by the unsuitability of the gauze as a background to the caps. Thus a cap 140 millimetres in height, when seen over the naked flame, was reduced to 47 millimetres when it was seen through the gauze; that is, the indication of 1 per cent. of gas was reduced to that for 0.5 per cent. This is probably the reason why the cap-heights actually seen do not at all agree with the heights shown on the scale-glass.

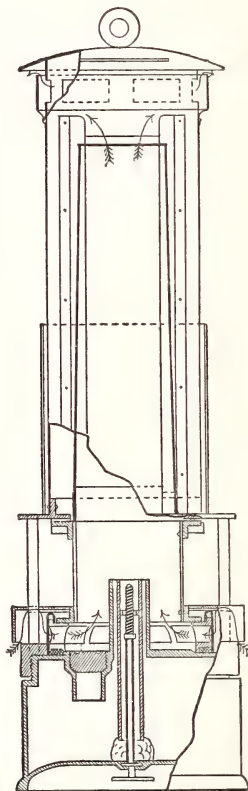
4. The range of testing with the alcohol flame is very limited, and becomes still more limited by the peculiarities of the lamp already

referred to. Another indicator must therefore always be at hand to supplement the Pieler lamp.

5. The inconvenience due to the necessity of carrying a second lamp together with the Pieler, and the fact that it becomes strongly heated if exposed to even a moderate amount of gas so as to lead to danger and to unfit it for further gas-testing for a long time, are also serious defects in this lamp.

M. Chesneau, in 1892, introduced another form of lamp, burning a large alcohol flame,

FIG. 4.



for gas-testing. The lamp is of the Fumat pattern, and takes its air feed from below the burner. The upper part of the lamp is isolated from the reservoir, so as to avoid the dangerous heating of the alcohol which occurs in the Pieler lamp. The construction of the lamp is further stated to provide for the total extinction of all flame within the lamp, when it is exposed to dangerous proportions of gas. (See Fig. 4.)

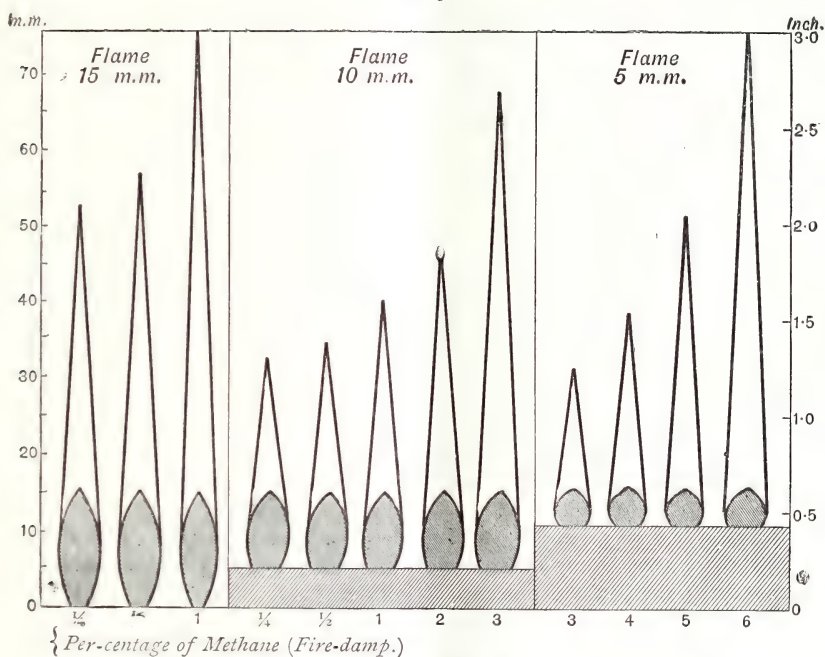
One of the principal advantages, however, which is claimed for this lamp, is the introduction of a copper-salt into the alcohol of

the reservoir; this leads to the flame and the caps being coloured, and thus renders them more visible. The salt originally used for this purpose was copper chloride. But both this salt, and the acid which must be used with it, corrode the reservoir and wick-tube, and lead to the formation of a deposit of cuprous chloride, which rapidly chokes the wick. Hence copper nitrate, together with some ethylene chloride has recently been dissolved in the alcohol in place of the copper chloride. This modification is stated to remove the serious inconvenience arising from the use of the copper chloride.

Experiments made with this lamp show:—

1. That the flame caps yielded by less than 1 per cent. of gas are much more distinctly seen than they are in the Pieler lamp, and agree with the lamp scale.
2. That caps yielded by more than 1 per cent of gas are hazy and difficult to measure, and are in no way superior to those which are seen in the Pieler lamp.
3. That the upper part of the alcohol flame is not more sharply defined than that in the Pieler lamp; a cap or halo is always visible over the flame even in gas-free air, and the flame cannot be set to height with

FIG. 5.



ACTUAL HEIGHT OF CAPS OVER HYDROGEN FLAME.

the precision necessary to yield standard results.

4. That the scale of the lamp being on the outside, can only be read by means of another lamp.

5. It may be added that the lamp is heavy and of complex construction, and that the array of precautions and directions, which appear to require attention when using this lamp is of formidable dimensions.

The Hydrogen Lamp.—The lecturer, in 1891, instituted experiments designed to ascertain the delicacy and accuracy of various types of gas-testing safety lamps. He devised for that purpose a special form of apparatus, the

"test-chamber," which will be hereafter described. This apparatus rendered it possible to observe with ease the caps which appeared over different test-flames, and to measure the heights of these caps with accuracy. He first observed and measured, by means of this apparatus, the caps which were produced over the ordinary flames of oil, benzoline, and alcohol in the testing-lamps already referred to, when these lamps were exposed to artificially-prepared mixtures in known proportions of gas and air. He then proceeded to make similar observations upon the caps seen over a naked hydrogen flame. The caps observed are represented in Fig. 5.

The comparison of the effects observed with the hydrogen flame with those produced by other flames at once convinced him of the great superiority of this flame over all others for gas-testing purposes. The principal advantages which this flame presented were the following :—

1. The flame is non-luminous, however large it may be, and requires no shielding from the eye; in fact, the observation of the flame assists in tracing and seeing the cap. This cannot be said of any other testing-flame, even the flame of alcohol being sufficiently luminous to interfere considerably with the perception of a faint cap.

2. Since the flame is fed with gas from a supply, it can be at once set with certainty and precision to standard dimensions, and is easily maintained in this condition; no wick-fed flame can be thus with certainty adjusted and maintained in adjustment.

3. The tip of the hydrogen flame is perfectly sharp and free from all haze or halo; even when the flame is of large dimensions, only a slender thread is seen proceeding from its tip. It is, therefore, not only possible to bring the tip of the flame to a scale mark with absolute certainty and precision, but there is also no difficulty in noting the first appearance of a cap. This is not true of any other flame which was tried, except that of unmixed colza oil, and this flame is found to be far too variable in character to be suitable for accurate testing.

4. The hydrogen flame gives larger and more visible caps than does any other flame of equal dimensions; thus, in the presence of 1 per cent. of coal-gas, the 10 mm. alcohol and hydrogen flames, and the small benzoline flame gave the following cap-heights :—

Hydrogen	27 mm.
Alcohol	19 "
Benzoline	7.2 "

Also, since the first appearance of a cap can be noted with absolute certainty (3), the caps yielded by 0.1 or 0.2 per cent. of gas are seen with a certainty, which cannot be felt when the alcohol flame is used. The flame also does not become luminous in the presence of larger percentages of gas, as the alcohol and oil-flames do; the perception of the caps is, therefore, not hindered as it is with the latter flames.

5. The hydrogen flame cannot be blown out by a vigorous air current, which at once extinguishes all other flames: hence, when used in a safety-lamp, it is unextinguishable

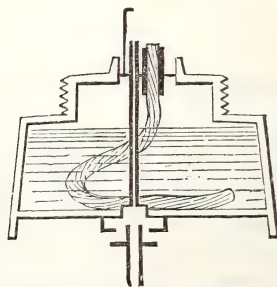
by rapid movements of the air or of the lamp, which are at once fatal to all other flames; in fact, the conditions met with in the mine fail altogether to extinguish this flame.

6. The hydrogen flame is at once extinguished by a dangerous amount of firedamp, but it requires for its extinction the presence of no less than 58 per cent. of carbonic acid or "choke-damp" in the air, whilst ordinary flames are extinguished by 15 per cent. of this gas. Accordingly, the use of the hydrogen flame provides against the risk of the troublesome and dangerous "loss of flame" in the mine, whether by choke-damp, or by rapid or sudden movement of the air or of the flame (5).

7. Whilst not suffering extinction by any amount of carbonic acid which would be found in the air of the mine, the hydrogen flame serves, by its change in colour, as a good indicator of the presence of carbonic acid.

It is manifest that a test-flame possessing these numerous advantages would be of great value, if it could be introduced in a safe and convenient way into the coal-mine for gas-testing purposes. The lecturer, accordingly, proceeded to endeavour to supply an ordinary safety-lamp with a store of hydrogen, by connecting it with a store of the gas compressed in a steel cylinder. The early experiments in the test-chamber were made with a stationary standard hydrogen flame, 10 millimetres (0.4 inch) in height. This flame was fed with hydrogen from a large steel cylinder, containing 40 cubic feet of gas. Such a cylinder was well suited to feed a stationary test-flame, but was too heavy and unwieldy to be portable. Accordingly, in 1892, the lecturer

FIG. 6.



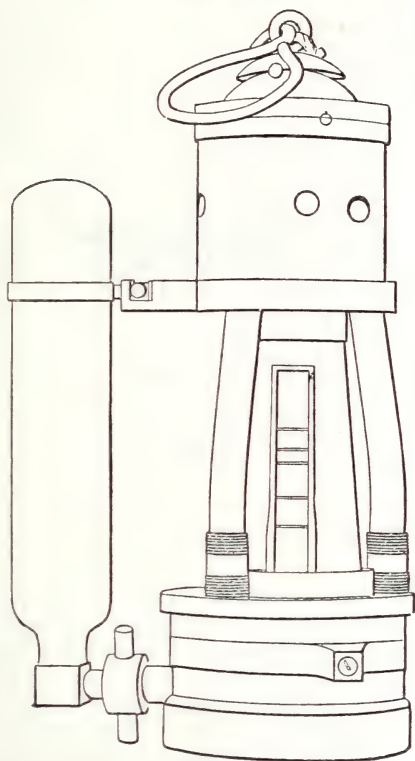
HYDROGEN OIL-LAMP (SECTION).

reduced its size until its weight was only 4 lbs. This smaller cylinder could be carried slung from the shoulder, and was connected by means of flexible tubing with a safety-lamp provided with a suitable jet for burning the gas. This hydrogen jet rose beside the wick-

tube, and on a level with it, so that when the hydrogen gas was turned on it was kindled by the oil flame; the lamp did not, therefore, require to be opened in order to light the hydrogen. In the early forms of the lamp the connection with the hydrogen jet was made at the bottom of the lamp (Fig. 6, p. 822); in the later forms it was found more convenient to place this connection at the side. The supply of hydrogen contained in the portable cylinder fed the standard hydrogen flame continuously for 16 hours.

This form of cylinder, with its flexible connecting tube, was considered to be somewhat

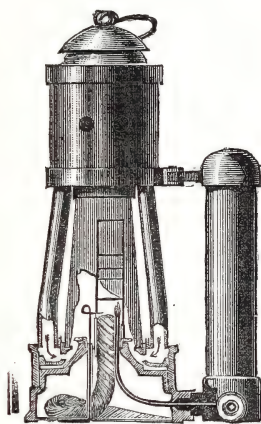
FIG. 7.



inconvenient when used in the mine, and it furnished an unnecessarily large supply of hydrogen. Accordingly, in 1893, the lecturer introduced a still smaller and lighter form of cylinder. This was designed to be easily carried in the pocket, and to be instantaneously attachable directly to the lamp itself when the hydrogen flame was required within the lamp. The cylinder, when attached, forms a convenient handle for supporting the lamp (Fig. 7). Several of these cylinders can be carried in the pocket without inconvenience, since the weight of each cylinder

is only 13 ounces. When fully charged with gas this cylinder supplies the standard flame for about two hours. The maximum pressure on the interior of the cylinder amounts to 1,600 lbs. per square inch; it is tested up to 3,000 lbs., and a pressure of 7,000 lbs. per square inch is found necessary to burst the metal. No danger need be feared, therefore, from the pressure within the cylinder; no accident has arisen, or could arise from this source, as has been shown by exposing the cylinders, when fully charged, to rougher usage than could be experienced when they are in use. The sectional drawing (Fig. 8) shows the construction and arrangement of the lamp and cylinder when they are connected and in use. In Figs. 7 and 8 there is shown also an opaque metal scale, which stands in front of the flame and of the cap, and which serves to set the

FIG. 8.



HYDROGEN-OIL TESTING-LAMP.

hydrogen flame to standard height, as well to enable the per-centage of gas present to be read off by observing the height of the cap. For this purpose a card is supplied with a scale similar to that shown in Fig. 9, p. 824.

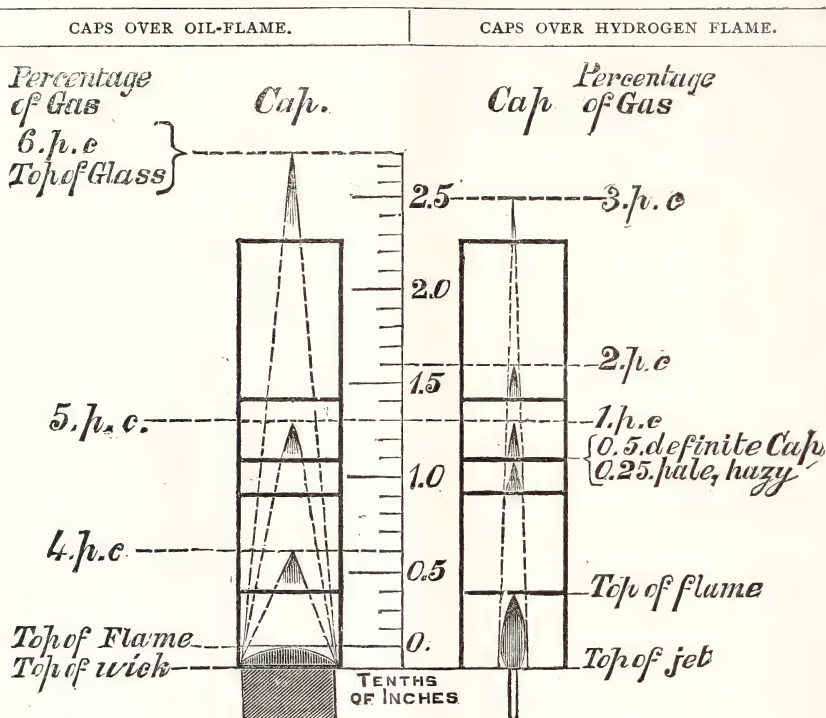
In setting the hydrogen flame, its tip is brought to touch the first division on the scale, which is precisely 0.4 inch (10 mm.) above the hydrogen jet. In the case of the caps, the scale division is fixed 0.2 inch below the extreme height of the cap. This is rendered necessary by the paleness of the tip of the cap, which, therefore, cannot be seen merely touching the scale, but is readily seen when it is crossed by the opaque scale mark. All attempts to use scales behind the flame ended in failure, since the hydrogen flame and caps were quite incompetent to illuminate such scales and

render them visible. It was necessary, therefore, to resort to an opaque scale standing in front of the flame, and thrown up as a black object by the flame or the cap behind it. This scale is fixed close to the flame, to avoid

error arising from the eye not being placed quite on the right level. The flame and caps are observed against the back of the lamp-glass, which is blackened in the interior to prevent reflection.

FIG. 9.

FLAME-CAPS SEEN AGAINST THE LAMP-SCALE.



The tip of the cap is 0.2 inch above the horizontal wire except for 6 p.c.

The charging of the small lamp cylinders is effected by connecting them with a large stock cylinder of compressed hydrogen. The operation is simple and rapid, and is effected with the greatest ease. A stock cylinder serves for giving a very large number of charges; it may either be kept at the colliery, or the small cylinders may be sent by parcels post, or otherwise, to a charging centre.

After the oil flame has been lighted in this composite safety-lamp, it may be made to burn either an oil flame alone, or a hydrogen flame alone, or both flames together, at will; and these changes may be effected instantaneously and without opening the lamp. The lamp is intended to be carried only by those officials whose duty it is to test for gas. When in use for ordinary lighting and testing purposes, the lamp is carried as usual, with the oil flame alone burning, and the hydrogen

cylinder is conveyed in the pocket. If gas is to be looked for, the oil flame is reduced in size by drawing down the wick until the flame is non-luminous, and if a cap is seen its height is measured against the scale. Such an observation serves to measure with sufficient accuracy per-centages of gas varying in amount from 3 to 6.

If no cap is observed over the reduced oil flame, the flame is raised to its ordinary height, and the hydrogen cylinder is connected with the lamp. The cylinder is held in the left hand, and serves to support the lamp, and the valve of the cylinder is then gradually opened by the right hand until the hydrogen escapes from the jet within the lamp. This is indicated by the projection of a tongue of flame from the top of the oil flame. The oil flame is then extinguished by drawing down the wick, and the hydrogen flame

is adjusted in height to the first scale division by regulating the cylinder valve. The flame-cap is then looked for, and if seen, it indicates and measures, with absolute certainty and precision, per-centages of gas varying from 0.25 to 3. When the oil flame is again required, the wick is pushed up and is kindled by contact with the hydrogen flame. The hydrogen flame is then extinguished by shutting off the cylinder valve, and the cylinder is detached and pocketed.

The whole procedure of making a hydrogen flame test, starting from and returning to the oil-flame, can be easily effected in 30 seconds.

Gas may be detected and measured throughout the whole range, from 0.25 to 6 per cent., means by of the hydrogen flame alone, if the flame is reduced to 0.2 inch in height for percentages from 3 to 6 per cent.; the indications for the lower per-centages may also be increased, if desired, by using a flame 0.6 inch in height (Fig. 5): this increase is, however, quite unnecessary.

When the two flames are burning side by side the "loss of flame," under any conditions which can occur in the mine, is impossible. The hydrogen flame cannot be extinguished, except by exposure to dangerous proportions of inflammable gas. No current of air or movement of the lamp, and no proportions of choke-damp which occur in the mine, can extinguish this flame, and as long as it burns it will rekindle the wick; advantage has been already taken of this fact, in exploring a pit after an explosion. This lamp was carried through parts of the pit which extinguished other lamps, and its flame was maintained under all conditions. The proportion of carbonic acid which extinguishes an oil flame or an alcohol flame is respirable: hence, when the hydrogen flame is used as an auxiliary flame, it enables a miner to enter into and back out of air, which extinguishes his oil flame, or even to pass through such air without losing his lighting flame, since the oil-wick becomes rekindled by the hydrogen flame, as soon as the lamp is brought into purer air.

The hydrogen tube in the lamp is absolutely impervious to flame, and not the slightest danger results from carrying the lamp into an inflammable atmosphere while the tube is open.

This composite lamp is now being used in many collieries. It has served to detect and measure gas in the "main returns" of several of our largest and best managed pits, much to the surprise of those who had hitherto tested for gas only by the ordinary safety-lamp. It

should be remembered, however, that if the gas is really swept out of the colliery by the ventilation current, this gas should be detectable in the air-current as it leaves the pit, provided only that a sufficiently delicate testing apparatus is employed. It is manifestly advantageous that this small proportion of gas should be detected and measured, since its variations in amount serve as a useful indication of the efficiency of ventilation in the whole colliery. If this delicate examination is extended to the "district returns," the opinion formed as to the condition of the ventilation is of a very complete and satisfactory nature. The lamp has also served, in some cases of the greatest importance, to ascertain when any gas, even in minute proportion, was present in the air of certain particular mines. Its employment for this purpose has been voluntarily undertaken by eminent scientific and practical mining authorities, who have compared its indications under standard testing conditions with those furnished by other lamps, and have been satisfied with its superiority both in delicacy and in trustworthiness.

Some of the advantages possessed by this composite hydrogen oil lamp may be thus summarised:—

1. It is at once a good lighting lamp, and a delicate and trustworthy gas-testing lamp. It requires, therefore, no second lamp to be carried with it, but only a small pocket attachment.

2. It is an ordinary safety-lamp, and is, therefore, not heavier or more complicated than those in common use.

3. It furnishes absolutely standard readings, by means of a flame which can always be set to size without doubt, and by caps at once seen without difficulty.

4. It is entirely free from all sources of danger.

5. It furnishes an auxiliary flame when necessary, which prevents any risk of loss of flame under any conditions which occur in the coal-mine.

The principle thus successfully introduced by the lecturer of combining a lighting lamp with a more delicate testing arrangement has been subsequently adopted, with modifications, both in this country and in France. The flame used to supplement the oil flame in these more recently devised lamps has been a small alcohol flame. The lecturer's own early experiments in gas-testing, by means of

a small alcohol flame, had led him to discard the flame altogether in favour of the hydrogen flame, for the following reasons:—

1. The alcohol flame was found to be too luminous to permit of the perception of small and faint flame-caps.

2. The caps produced over such a flame by small per-centages of gas, even when the flame was screened from the eye, were smaller and much less distinct than those seen over the unscreened hydrogen flame.

3. The flame, on account of its hazy top, could not be set with any certainty to a standard height; and, owing to the variations in the wick and in the temperature of the alcohol reservoir, the flame underwent rapid changes in size and character, which rendered it unfit for measurement of gas.

4. The flame also showed a cap, or halo, in pure air, which is easily confounded with slight cap indications; whilst it became so luminous in the presence of larger proportions of gas as to hinder seriously the perception of the cap.

5. When an alcohol flame was used in an ordinary safety-lamp which had been in use for half-an-hour, the lamp-glass became somewhat dimmed. Under these circumstances, no distinct cap was perceptible over the alcohol flame when less than 1.5 per cent. of methane or fire-damp was present in the air. Under precisely the same conditions, the hydrogen standard flame showed an unmistakeable cap in the presence of 0.2 per cent. of the gas. When the alcohol flame is surrounded by a lamp-glass, the interference caused by the reflection of its light from the glass becomes serious.

6. It may be added that considerable difficulty is often experienced in kindling the alcohol wick from the oil flame, and that this is occasionally either not effected at all, or only with the total loss of flame in the lamp. The alcohol flame is also lost in the mine with even greater ease than the oil flame; and the application of alcohol to the ordinary safety-lamp has not hitherto been effected with absolute security from danger.

Notes on Books.

LAW AND THEORY IN CHEMISTRY. By Douglas Carnegie, M.A. London: Longmans. 1894.

Mr. Carnegie calls this "a companion book for students." It is a reprint of eight lectures delivered

before an audience of teachers of chemistry at Colorado Springs, U.S.A. The course practically consists of as many essays on chemical philosophy, treating respectively of "Alchemy and the birth of scientific chemistry," "The phlogistic period and the beginnings of chemical theory," "Chemical classification," "The atomic theory," "The classification of compounds, acids, bases, salts," "Isomerism and molecular architecture," "Chemical equilibrium." The book does not profess to be an elementary one. It assumes a fair amount of chemical knowledge in the reader. The author's aim in his own words is "to treat of those subjects which are essential to a liberal understanding of the science, but which are inadequately treated in, or altogether crowded out of, the current text-books of elementary chemistry." The earlier chapters, in which the subject is treated to a certain extent historically, can be read with interest by anybody possessing an elementary knowledge of the science. The later parts of the book, in which the more modern theories of chemistry are dealt with, can only be profitably studied by those who are already tolerably familiar with those theories.

ELEMENTARY TREATISE ON NATURAL PHILOSOPHY, Based on the "Traité de Physique" of A. Privat Deschanel. By J. D. Everett, F.R.S. Thirteenth edition. London: Blackie and Son, 1894.

A work that has gone through thirteen editions cannot need much introduction to the public, and the fame of Deschanel's "Natural Philosophy" is so well established, that little need be said in its praise. The march of science is now-a-days so rapid, that a text-book such as this needs constant revision and re-arrangement, and to fit it to present requirements this thirteenth edition has been almost entirely rewritten. As might be expected, the vast growth of the science and practice of electricity has necessitated the re-casting of Part III., which is devoted to Electricity and Magnetism. In this department the results of the latest researches are included, and special descriptions are given of Tesla's experiments on rapidly alternating discharges, of series and shunt dynamos, of series and shunt motors, of accumulators and transformers, and of electric welding. Part 4, which is devoted to Sound and Light, has also undergone a complete re-arrangement, so as to make it a satisfactory text-book for these classes of mathematical physics; considerable changes have also been made in Parts I. and II. In Part I. the latest information respecting weather prediction and weather charts is given, and in Part II. a new chapter on Thermodynamics has been added. In order to find room for the large additions which have been made, it has been necessary to leave out a certain amount of matter, which was considered superfluous, but, in spite of this, the book has increased in size. A full index completes the work, and a reference to the items in this index has proved that the editor's claim to completeness of treatment is well justified.

Journal of the Society of Arts.

No. 2,182. VOL. XLII.

FRIDAY, SEPTEMBER 14, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

"OWEN JONES" PRIZE.

This competition was instituted, in 1878, by the Council of the Society of Arts, as trustees of the sum of £400, presented to them by the Owen Jones Memorial Committee, being the balance of subscriptions to that fund, upon condition of their expending the interest thereof in prizes to "Students of the School of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones." The prizes are awarded on the results of the annual competition of the Science and Art Department.

Six prizes were offered for competition in the present year, each prize consisting of a bound copy of Owen Jones's "Principles of Design," and a Bronze Medal.

The following is a list of the successful candidates:—

Appleyard, Fred., School of Art, Scarborough.—Design for wall paper.

Gillick, Ernest G., School of Art, Nottingham.—Design for lace curtain.

Slater, Lillie G. M., School of Art, Scarborough.—Design for a damask.

Smith, Constance T., School of Art, Glasgow.—Design for a printed velvet.

Francis Edwin, School of Art, Durham.—Design for a carpet.

Palmer, Samuel, School of Art, Macclesfield.—Design for floor tiles.

The next award will be made in 1895, when six prizes will be offered for competition.

Proceedings of the Society.

CANTOR LECTURES.

THE DETECTION AND ESTIMATION OF SMALL QUANTITIES OF INFLAMMABLE GAS OR VAPOUR IN THE AIR.

BY FRANK CLOWES, D.Sc.Lond., F.I.C.,

Professor of Chemistry in the University College, Nottingham.

Lecture IV.—Delivered February 12.

GAS-TESTING, AS AT PRESENT IN VOGUE IN THE COAL-MINE.

The account which has been presented of the development of methods of gas-testing in coal-mines, shows that much more efficient methods are available than were known even a few years ago. The manager can now have an examination for gas made by simple and trustworthy means, and the proportion of gas present can be reported to him even as low as 0.1 per cent.

The remarkable diminution of damage to property, and of injury and fatality to men from explosions in the mine, which has been progressively secured since Government inspection of collieries was introduced, shows how much the security of the mine may be advanced by the regular observance of suitable and reasonable precautions. When it is remembered that in the method of gas-testing adopted in the coal-mine practically no advance has been made during that period, it will be understood that at least one cause remains which will account for the explosions which still occur. In most of our English coal-mines it is still considered satisfactory to report "no gas present," after testing with a lamp, which confessedly cannot detect, with certainty, less than 3 per cent. of gas. Such reports are made in despite of the knowledge that only very bad ventilation could permit of 3 per cent. of gas being present in the purer part of the mine-air, and in the face of the statement, made on the best authority, that less than 1 per cent. of gas is sufficient to render air containing a suitable amount and kind of fine coal-dust violently explosive.

The Royal Commissioners on Coal-dust are of opinion that there is "no probability that a dangerous explosion of coal-dust alone could ever be produced in a mine by a naked light or ordinary flame," but that it may originate in "a blown-out shot or other violent inflamma-

tion. To produce such a result, however, the conditions must be exceptional, and are only likely to be produced on rare occasions." On the other hand, "the danger of explosion in a mine in which gas exists, even in very small quantities, is greatly increased by the presence of dust. Different dusts are inflammable, and consequently dangerous, in varying degrees; but it cannot be said, with absolute certainty, that any dust is entirely free from risk." Such statements represent not only the opinion of the Royal Commissioners, but the opinions, also, of those practical authorities, who have given their evidence before the Commission. They immensely strengthen the view already stated, that in neglecting suitable and satisfactory methods of gas-testing in the coal-mines, and in being content to state that the absence of a minimum quantity of 3 per cent. of gas, which is all that is now possible of detection, means "no gas present," our colliery managers are pursuing a policy fraught with danger, and are content to remain altogether behind the state of present knowledge in one of the most important departments for securing the safety of the mine and of its numerous inmates.

TESTING FOR PETROLEUM-VAPOUR BY THE HYDROGEN-FLAME.

The eminent suitability of the hydrogen-flame to testing for firedamp suggested its applicability to the detection and measurement of other inflammable gases or vapours in the air. Mr. Boverton Redwood has been the first to adopt the hydrogen flame test, as the best means of ascertaining that the atmosphere of the empty tanks of petroleum steamers are completely freed from inflammable vapour. It is necessary to make sure that this is the case before the tanks can be entered with safety to the health of workmen, and with immunity from risk of fire and explosion when lights are introduced or red-hot rivets are taken into the tanks for repairs. Many disastrous explosions have occurred before this precaution of testing the tank atmosphere was resorted to, and the test is therefore now obligatory after a steamer has discharged its cargo of oil, and before the tanks are entered. Precautions of a similar nature should undoubtedly be adopted in all cases where light petroleum oil, or preparations containing light petroleum oil, have been used or stored in more or less closed spaces.

In a paper read by him before the Institution of Civil Engineers in February of this year (Proc. Instit. Civil Engineers, vol. cxvi., Part

II.), Mr. Redwood refers to the unsatisfactory nature of the results furnished by the various testing apparatus described in these lectures, with the exception only of the hydrogen flame test. Mr. Redwood has in his own professional experience carried out many tests with the alcohol flame; but he unhesitatingly discarded the use of this flame, and of all other tests, after a few trials of the hydrogen flame.

The hydrogen safety-lamp, as described for use in the coal-mine, is applicable, under special conditions, for testing for petroleum vapour in the air. Thus, when the proportion of the vapour is known to be so small as not to render the respiration of the air dangerous, and when the vapour is pretty uniformly diffused throughout the air, the observer could certainly descend with the lamp and make the necessary observations and measurements, as is done in the coal-mine. But these conditions frequently do not exist in the oil-tanks of the steamer. Petroleum vapour is much heavier than air, and tends, therefore, to collect in larger proportion near the bottom of the tank: for the same reason, it is slow in mingling uniformly by diffusion with the air in the tank. Hence it is frequently doubtfully safe for the observer to enter the tank, and even if he entered with a portable lamp, it would be difficult to make observations with the safety-lamp when it was lowered to the floor, and was below the level of the eye.

Considerations of convenience have induced Mr. Redwood to introduce the standard hydrogen flame into an apparatus of special construction (Fig. 1, p. 829). This apparatus is represented in the figure arranged in readiness for a test. The hydrogen flame is fed from the cylinder of compressed gas, and the sample of air to be tested for petroleum vapour, which has been previously compressed in the metal vessel shown, is allowed to escape into the base of the testing apparatus, and to surround the hydrogen flame as it passes upwards to escape at the top of the test apparatus. If any cap is produced, it is seen through the glass front of the apparatus, and its height may be noted on a permanent scale upon the glass. An upright rod with two horizontal arms supports a black cloth, by means of which the observer can exclude surrounding light whilst observing the hydrogen flame.

The testing-apparatus is provided with a series of wire-gauze baffles in its lower part. Since the air to be tested must pass through these before reaching the hydrogen flame, all

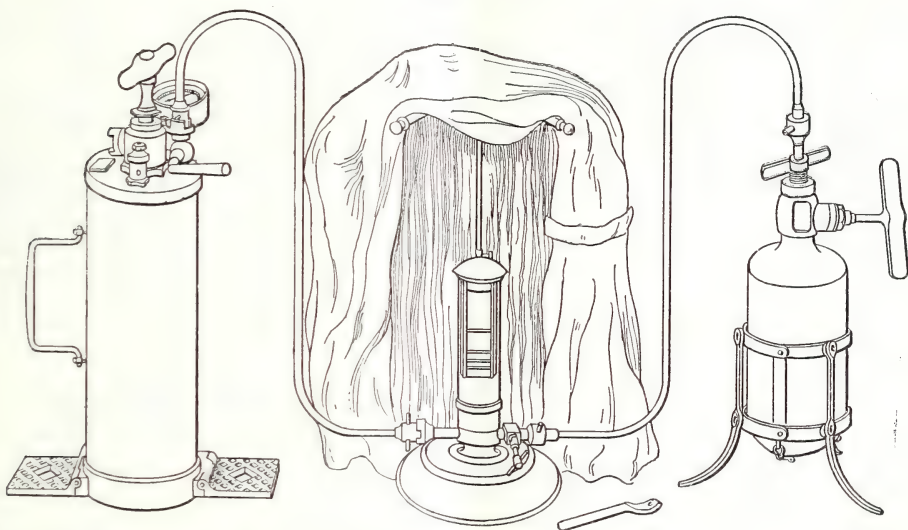
risk of petroleum-charged air firing back into the reservoir is avoided. The upper cylindrical part of the test apparatus is made mainly of metal, blackened inside, but is fitted with glass in front, and is only loosely covered with a mushroom head, which allows of free egress of gas. The cylindrical part fits air-tight upon the base, but can be raised, so as to admit fresh air, when necessary, for the maintenance of the hydrogen flame.

When the apparatus is to be used for a test, the hydrogen supply from the cylinder is connected with the jet in the testing apparatus; the cylindrical chimney is raised, and the hydrogen is turned on and lighted at the jet. The hydrogen flame is then regulated, roughly, to standard height (0·4 inch), and the chimney is lowered, until a small supply of

air only is admitted below to maintain the combustion of the hydrogen flame. The vessel in which the sample of air to be tested is contained is now connected up. As soon as the chimney is warm, and no condensed moisture remains on the glass, the chimney is pushed down, so as to shut off the air-inlet; the hydrogen flame is then finally set exactly to standard height, by making its tip just level with the bottom of the glass, and the supply of the air to be tested is then turned fully on. The air enters through a small nozzle, and its discharge lasts for fully two minutes, giving ample time for the detection and measurement of any flame-cap which may be produced.

Mr. Redwood's experiments show that a distinct cap is visible when the proportion of

FIG. 1.



petroleum vapour in the air amounts to only one-ninth of the quantity which makes the air inflammable, and one-eighteenth of the quantity which causes the air to be explosive. He considers, therefore, that "the test is a delicate one," and that "if the interior of the tank or other space be ventilated, until a sample of the atmosphere gives no flame-cap with this apparatus, an ample margin of safety will be provided." "The lamp and its accessories have now been in practical use for some time past, and have been found to answer their purpose very well." Full information concerning the construction and use of the collecting vessel, and full details of Mr. Redwood's experiments made to ascertain the inflammable and explosive limits of mixtures of air with petroleum vapour, will be found in the

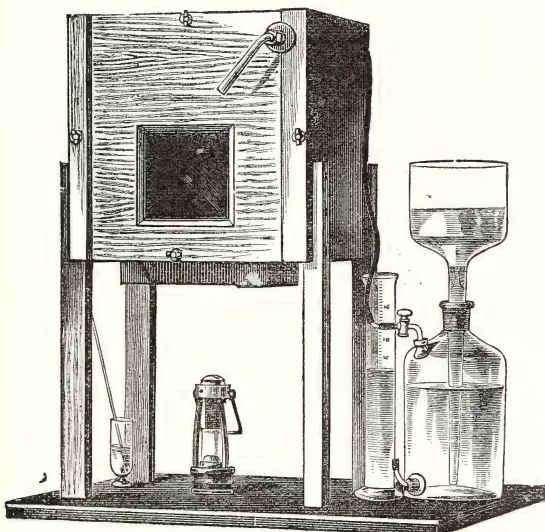
paper already referred to. This paper is further illustrated with admirable coloured reproductions from original photographs, of the standard hydrogen flame and its flame-caps. These are represented in their actual size and colour, so as to serve as a guide to the observer who has not yet become experienced in the judgment of flame-cap indications.

THE "TEST-CHAMBER" FOR OBSERVING FLAME-CAPS.

As has been already stated, the lecturer was led in the earliest stages of his investigation to devise an apparatus in which artificial mixtures of inflammable gas or vapour with air could be rapidly and conveniently prepared in known proportions, and in which the caps seen over testing-flames could be carefully observed

and measured. The "test-chamber" which was devised for this purpose has answered its purpose admirably, and has already been largely used not only for the original observations already referred to, but also for the purpose of showing to inspectors of mines, to colliery officials and mining engineers, and to others interested in coal-mines, the flame-cap appearances corresponding to different per-centages of gas. It may be noted that in this country no other form of apparatus exists which enables the relative merits of different forms of gas-testing apparatus to be ascertained, or which furnishes a simple and rapid means of familiarising those who use such apparatus with the indications which they have to observe in the coal-mine. Observations in the coal-

FIG. 2.



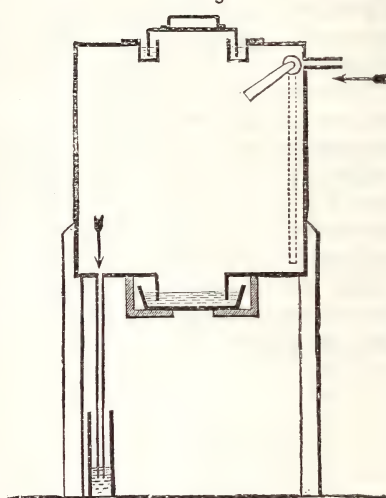
TEST-CHAMBER.

mine alone are without value for this purpose, since the known per-centages of gas are not there available. It cannot be doubted that if the test-chamber were more generally available for the use of Government inspectors of mines and of colliery officials, a more satisfactory and discriminating selection of gas-testing apparatus would be made, or a more efficient use of the very imperfect methods now in vogue would be possible.

The test-chamber, as at present employed by the lecturer, consists of a suitably supported gas-tight wooden box, provided with large openings above and below which can be closed gas-tight, and furnished with an observation window in front. (Figs. 2, 3, 4.) An inlet is provided near the top of the box for the intro-

duction of the measured volume of the light inflammable gas; an escape for the heavier air displaced by this gas is provided at the bottom of the chamber (Fig. 3). The gas is

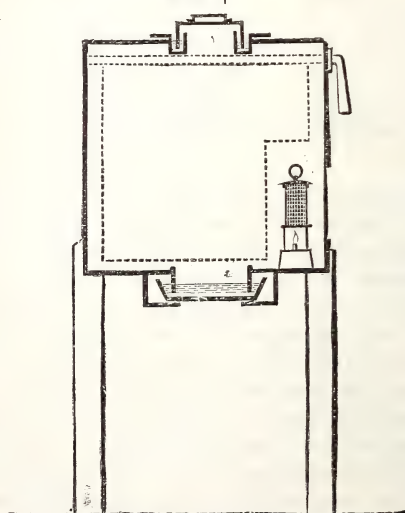
FIG. 3.



TEST-CHAMBER (SECTION—FRONT).

supplied to the chamber from an ordinary glass gas-holder (Fig. 2), by connecting the gas-holder with the chamber, then pouring into the top of the gas-holder a volume of water equal to the volume of gas required, and allowing this water to flow into the lower

FIG. 4.



TEST-CHAMBER (SECTION—SIDE).

part of the holder and expel the gas into the chamber. As soon as the gas has been introduced, it is thoroughly mingled with the air of the chamber by swinging up and down a light

wooden flap, shown by dotted lines in Fig. 4. This flap is moved by means of a handle projecting from the front of the chamber. A mixture of air with gas in precisely known proportions is prepared in this way in the course of two or three minutes. The lamp to be examined is introduced into the chamber through the lower opening, and is observed through the window in front.

The observations should be made in a room from which daylight is excluded. Subdued candle or gas light, or light from the safety-lamp in the room around the chamber causes little interference, especially if the head is shielded from this light by a dark camera cloth, suspended from the front of the chamber while the observation is being made. For the accurate observation of faint flame-caps it is absolutely necessary that the eye shall not have been exposed to daylight or other powerful light for at least 15 to 20 minutes prior to the observation. It is also worthy of note that a faint cap is more readily seen if the eye is directed to a point to one side of the flame instead of at the flame itself: thus, by looking at the side of the lamp, a cap becomes clearly visible, which is difficult of perception by a direct inspection.

The gas used in the lecturer's experiments was chemically prepared methane, or marsh gas, since this is the inflammable gas actually present in firedamp. The results thus obtained were confirmed by repeating the experiments with firedamp of known composition. The indications were identical in both sets of experiments, when the proportions of methane present in the chamber were the same. The indications furnished by coal-gas are fairly similar to those yielded by marsh-gas, as is shown by the tabulated results which follow, but in accurate determinations coal-gas cannot be used.

The accurate measurement of flame-caps was made by pressing an ordinary parallel rule upon a strip of paper against the glass in front of the chamber. The edges of the rule were made visible by priming them with luminous paint. The rule was opened, until it exactly included the space between the top of the test flame and the top of the cap. This space was marked upon the paper strip by means of a sharp pencil, and was measured afterwards against a scale graduated into tenths of an inch or into millimetres. The height thus obtained was then corrected for the distance of the paper strip from the caps, and thus the true cap-height was obtained. This somewhat indirect method of measure-

ment was rendered necessary by the fact that a scale placed close behind the cap could not be read by the light of the pale cap alone.

When a fresh per-centage of gas was to be mingled with the air in the test-chamber, the chamber was filled with fresh air by opening both top and bottom apertures. The atmosphere of the chamber was thus replaced with fresh air in the course of two minutes; this interval could be much lessened if the flap was swung in the chamber, while it was open above and below.

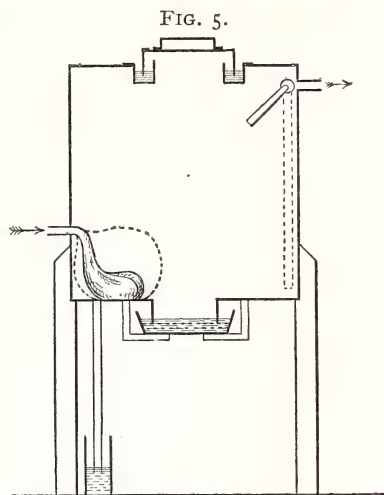
The opening of the lower aperture of the chamber alone continuously for five minutes, or for the introduction and removal of several safety-lamps, was found not to produce any perceptible effect upon the composition of the air within the chamber. The small flame usually employed in gas-testing, when burning in the chamber for at least 20 minutes, also did not alter the mixture; the large alcohol flame of the Pieler lamp however rapidly changed the composition of the mixture.

It may be further stated that the chamber was made to inclose exactly 100 litres of air. Accordingly the introduction of 1 litre of gas gave a 1 per cent. mixture, and the other percentage proportions were obtained in an equally simple manner. The chamber was blackened inside, and was then brushed over inside and outside with melted paraffin wax to make it gas-tight. The upper and lower openings were closed by water-seals, in the manner indicated in Figs. 2 and 3, to secure air-tight closure: the lower tray is swung on bars from the bottom of the chamber. A small circular opening in the front of the floor of the chamber was also necessary, when the reduced oil flame was being used, so as to enable the observer to adjust the wick by means of the "pricker," and thus to arrest the constant dropping of the flame, which, if unchecked, rapidly leads to its total extinction. This hole is closed, when not in use, by a suitable flap.

In the experiments made by Mr. Redwood, in which known proportions of petroleum vapour were introduced, the requisite volume of the light petroleum oil was allowed to flow into the chamber upon the surface of the mixing flap: the swinging of the flap caused the evaporation of the liquid, and the simultaneous mixture of its vapour with the air of the chamber.

Before an accurately known volume of gas can be introduced in starting the experiments, it is obviously necessary to allow the gas to stream out of the holder, through the length of the rubber tube connecting the gas-holder

with the chamber, so as to displace the air from this tube; then to shut off the water-pressure in the holder, so as to leave the gas under atmospheric pressure only. This rubber tube is then at once clamped close to its upper end, which is then connected with the



ARRANGEMENT FOR SUPPLYING GASEOUS MIXTURE FROM THE TEST-CHAMBER.

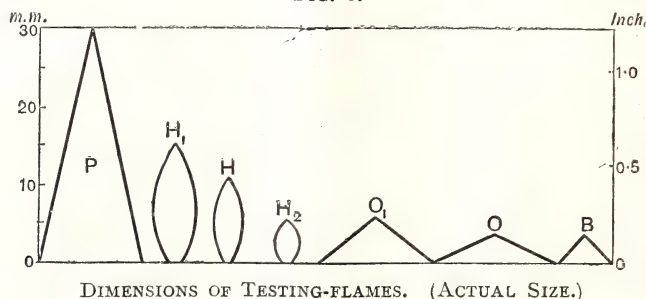
chamber. As soon as the necessary volume of gas has been introduced into the chamber, and the gas in the holder is again at atmospheric pressure, the upper part of this rubber tube is again clamped, to prevent diffusion occurring between the gas in the tube and the air of the chamber.

Mr. James Grundy adapted the test-chamber to deliver its mixture of air and gas made in known proportions, into other forms of testing apparatus which cannot well be introduced into the chamber, in the way shown in Fig. 5. A bladder was introduced into the chamber, and its neck was connected with a short pipe, which passed air-tight through the side of the chamber. Before the mixture of gas and air was made in the chamber, the bladder was emptied of air by suction at the open end of the tube. After the mixture had been made, the bladder was inflated by blowing down the tube from outside the chamber, and the gaseous mixture was thus expelled from the outlet tube in the chamber, and was received into any suitable apparatus. Mr. Grundy applied this method for introducing the gaseous mixture into the Liveing's indicator.

HEIGHTS OF TEST-FLAMES AND FLAME-CAP MEASUREMENTS MADE IN THE TEST-CHAMBER.

All the lecturer's measurements of cap-heights were made by means of the test-chamber. Those which have not been already stated are here appended in tabular and in diagrammatic form. It may be noted that the only measurements which, on repetition, were closely accordant, were those of the hydrogen flame: in the case of other test-flames, the numbers given are the average results of several more or less differing readings.

FIG. 6.



DIMENSIONS OF TESTING-FLAMES. (ACTUAL SIZE.)

Measurements of Testing-flames.—In the diagram (Fig. 6) the flames are indicated by the initials of the names in the table, P denoting the Pieler flame, H the hydrogen, O the oil, and B the benzoline flame. The heights are stated in millimetres (m.m.) and in inches. The heights of the oil flames are only roughly approximate, since they vary much. The Pieler and Ashworth benzoline flames also cannot be adjusted with absolute certainty, owing to their hazy tips. The hydrogen flame-heights are absolute and invariable.

DIMENSIONS OF TESTING FLAMES.

	Height.		Diameter at broadest part.	
	mm.	inch.	mm.	inch
Hydrogen flame (round).....	10	0.4	5	0.2
	15	0.6	6	0.24
	5	0.2	4	0.16
Pieler flame (round, conical)	30	1.2	13	0.52
Benzoline flame (round, conical)...	3	0.12	7	0.28
Oil flame (flat, slightly conical) }	3	0.12	13	0.52
	6	0.24	13	0.52

Flame-cap Measurements with different Gas-testing Lamps in Air containing Methane.—Those marked with a query (?) are uncertain and cannot be relied upon.

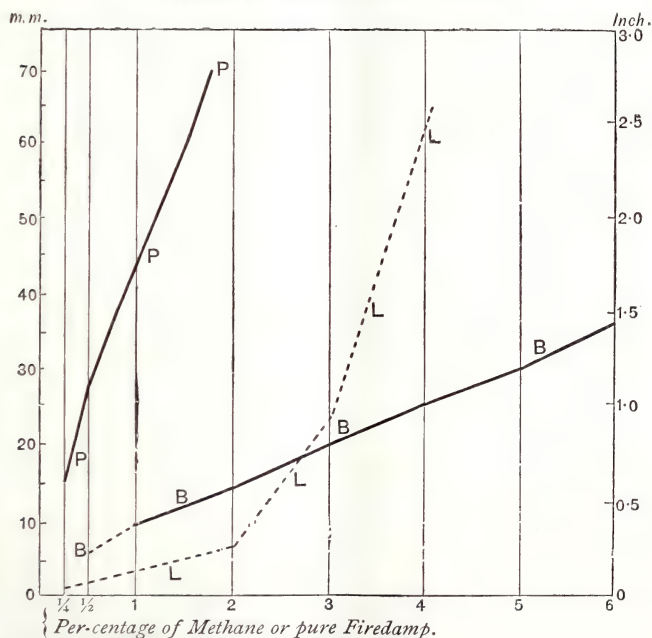
HEIGHTS OF TESTING-FLAMES AND CAP-HEIGHTS, WITH KNOWN PER-CENTAGES OF METHANE, OR PURE FIREDAMP.

Per-centage of Methane Present in the Air.	Hydrogen flame.			Pieler Alcohol flame. 30 mm.	Ashworth's Benzoline. 3 mm.	Colza-petroleum flat flame.	
	Standard 10 mm.	15 mm. in the Gas.	5 mm. in the Gas.			Small blue 3 mm.	Flame partly luminous. 6 mm.
0.25	17	37	—	30 (?)	—	—	—
0.5	18	42	—	55	7 (?)	—	—
1.0	22	60	—	90	10	—	—
2.0	31	{ enters top of lamp. }	—	{ 140 reaches top of lamp }	14	7.5 (?)	7.5 (?)
3.0	52	—	14.5	—	20	7.5	7.5
4.0	{ enters top of lamp }	—	22.2	—	25	12.0	24.0
5.0	{ enters top of lamp }	—	35.0	—	30	29.0	41.0
6.0	{ enters top of lamp }	—	60.0	—	35	67.0	{ enters top of lamp. }

Multiply millimetres by 0.04 to convert them to inches.

FIG. 7.

FIREDAMP INDICATIONS TO SCALE.

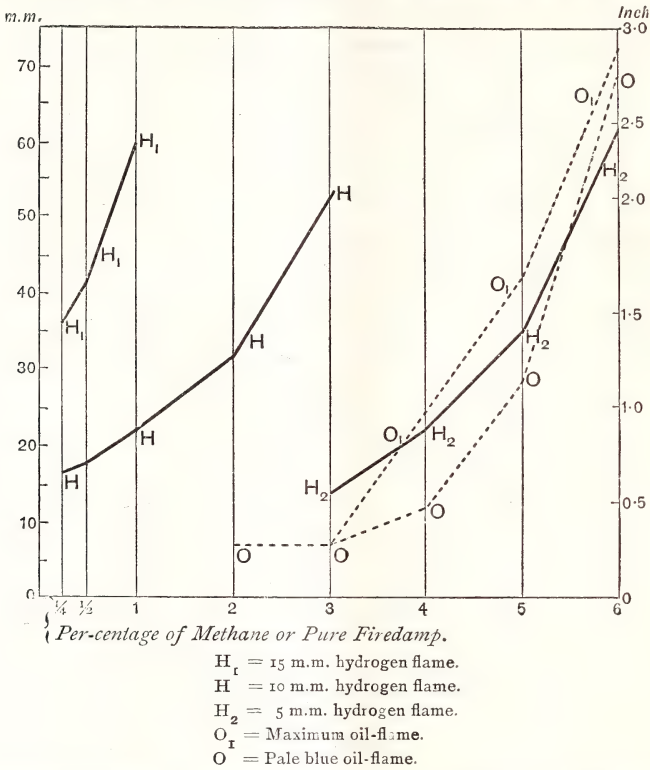


P = Caps over Pieler alcohol flame (one-half height).

B = Caps over Ashworth benzoline flame (full height).

L = Liveing's electrical indicator, relation between light emitted by covered and exposed spirals.

FIG. 8.
CAP-HEIGHTS WITH HYDROGEN-OIL-LAMP. (ACTUAL SIZE.)



Flame-cap Measurements in Air containing Coal-gas.—The results show that the standard hydrogen flame furnishes indications for coal-gas about equal to those for methane when the proportions are small, but that the coal-gas readings are higher than those for methane

when 1 per cent. or upwards of the gas is present. The water-gas used was of average composition; the standard hydrogen flame readily detects proportions of this very poisonous gas in the air, which are distinctly less than those which are pronounced to be dangerous to life.

CAP-HEIGHTS OVER HYDROGEN STANDARD FLAME WITH COAL-GAS.

Per-centage of coal-gas in the air.	Cap-height in mm. over Hydrogen Flame.			Cap - height in mm. over oil flame reduced until the cap is at maximum.
	Standard 10 mm. flame.	Flame raised to 15 mm. in the gas.	Flame reduced to 5 mm. in the gas.	
0.25	15.7	27.6	—	—
0.5	18.4	37.0	—	—
1.0	25.3	60.0	—	—
2.0	40.6	—	—	—
3.0	60.0	—	11.5	15.3
4.0	—	—	30.0	20.0
5.0	—	—	60.0	34.5
6.0	—	—	enters top	65.0 (over)

If these heights are required in inches, they should be multiplied by 0.04.

CAP-HEIGHTS OVER STANDARD HYDROGEN FLAME WITH WATER-GAS.

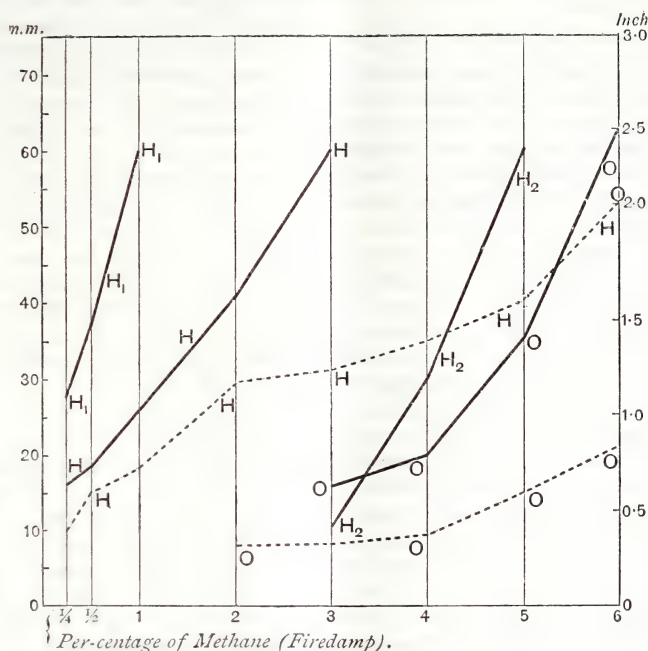
Per-centage of water-gas in the air.	Hydrogen Flame.			Colza-petroleum flame maximum size.
	10 mm.	15 m.m. in the gas.	5 mm. in the gas.	
0.25	10	25.3	Nil.	Nil.
0.5	14.5	33	"	"
1.0	17.2	—	"	"
2.0	28.7	—	"	8
3.0	31.4	—	"	8
4.0	*36	—	"	9
5.0	*40	—	11	14.5
6.0	*50.6	—	26	20

* In these measurements the tail-like prolongation of the conical cap was not included.

The millimetre measurements are converted into inches when multiplied by 0.04.

FIG. 9.

HEIGHTS OF CAPS OVER HYDROGEN FLAME IN COAL-GAS AND IN WATER-GAS.



The dotted curves are for water-gas.

H₁ = 15 m.m. hydrogen flame.

H = Standard 10 m.m. hydrogen flame.

H₂ = 5 m.m. hydrogen flame.

O = Oil-flame giving maximum cap.

N.B.—The tail or streak above the cap was not measured in for 5 and 6 per cent. of water-gas.

Measurements of Cap-heights over Standard Hydrogen Flame in Petroleum (Pentane) Vapour.—The per-centages of vapour present were calculated by Mr. Redwood; the caps were measured by the lecturer from the coloured cap diagrams already referred to as illustrating Mr. Redwood's paper read before the Institute of Civil Engineers.

CAP-HEIGHTS OVER STANDARD HYDROGEN FLAME PRODUCED BY PENTANE VAPOUR.

Calculated per-centage of pentane vapour present in the air.	Height, in millimetres, of cap over standard hydrogen flame.
0.144	7
0.288	10
0.576	20
0.96	25
1.15	40

Measurements of known per-centages of Methane by the Liveing's Indicator.—The following measurements, made by Mr. James

Grundy, seem to show that for very low fractions of a per cent. the readings are variable; but that for 0.5 per cent. and upwards, very satisfactory indications are obtained.

MEASUREMENT OF METHANE BY THE LIVEING INDICATOR.

Per-centage of methane (firedamp) present in air.	Per-centage indicated by Liveing's apparatus in several experiments.
0.05	0.05 (several experiments).
0.11	0.11, 0.13, 0.12, 0.11
0.165	{ 0.150, 0.140, 0.300, 0.320 0.200, 0.200, 0.220, 0.220
0.225	{ 0.230, 0.320, 0.280 0.320, 0.260, 0.260
0.275	{ 0.200, 0.400, 0.280, 0.380 0.300, 0.280, 0.370, 0.320
0.300	{ 0.250 0.300, 0.340, 0.380, 0.470 0.330, 0.350
0.5 to 2.2	{ Results of remarkable accuracy were obtained.

Miscellaneous.

THE ECONOMIC CONDITION OF JAPAN.

The total area of the Empire of Japan, according to the latest return, is 148,000 square miles, with a population of about 41,000,000. A correspondent of the *Economiste Français* says that as the country has dependencies of more than five hundred islands it is difficult to tell whether the population of all the islands is comprised in the above total. The population itself is distributed among two races which are quite distinct—the Ainos, who are the original inhabitants of the Isle of Yezo and in the north of Nippon, and the Japanese themselves. As regards territory and population Japan cannot be compared with China. It has only a tenth of the population of the latter, and about an eleventh part of its territory, and this is excluding the dependencies of the Celestial Empire. The contrast is very great in other respects—flora, fauna, institutions, finances, cultivation, &c. As regards its productive forces, they are also very dissimilar. Consequent upon the nature of the soil, a large part of the Japanese territory is not cultivable. It requires all the labour, skill, and extreme sobriety of the Japanese to find the means of subsistence for the people. It is true that that portion of the land which is cultivable is of wonderful fertility, due to the volcanic beds and the prevalence of rain. The flora of Japan is of incomparable richness, and the same may be said of the fauna. Japan is like China, the country of flowers, but it excels China in the wealth of its trees, which are of a most varied and rare description. Firs, cedars, chestnuts, oaks, beeches, and elms abound, and to these may be added orange trees, camphor trees, wax trees, and mulberry trees. Several extinct volcanoes, particularly Fusi-Yama, are covered with forests in a perfect state, which are of incaluable wealth to the country. As regards the fauna of the country, there is a varied assortment, but without wild beasts. Japan possesses numerous watercourses and lakes, which are well stocked with fish. Moreover, the coasts abound in fish of every description. Without fish, in the Pacific, the Japanese would be unable to exist, for this forms the chief means of subsistence. The climate would be perhaps one of the best in the world if the rains were a little less frequent. It is colder in winter than the south of France, on account of the high mountains, and in summer it is not so hot as in Spain. Agriculture holds a high place in Japan among the industries of the country, but it is by no means so important an industry as in China, one reason being the small extent of cultivable land, and another the preference of the Japanese for indoor industrial occupations. The principal articles of cultivation are rice, rye, wheat, barley, buckwheat, rape, millet, and oats. Rice is the principal crop, as it forms the basis of the food and drink of the people,

that and fish being the chief articles of diet. As regards live stock, there were, according to the latest returns, 459,000 oxen, 662,000 cows, and 1,565,000 horses. After cereals and cattle, the principal products of the country are silk, vegetable wax, tea, and sugar, and in the cultivation of these articles the Japanese excel. The quantity of tea produced in 1892 amounted to about 58,000,000 pounds, sugar 107,000,000 pounds, raw silk 12,000,000 pounds, rice 205,000,000 bushels, barley 34,000,000 bushels, and rye 30,000,000 bushels. As regards the mining industry of the country, coal was produced in 1890 to the extent of 2,600,000 tons, silver 1,700,000 ounces, copper 18,000 tons, iron 18,000 tons, and sulphur 20,000 tons. The product of the cotton weaving industry represented a value of £2,000,000; silk weaving, £1,880,000, and silk and cotton mixed, £720,000.

The foreign commerce of the country has considerably developed of recent years. In 1880 the value of the imports was 37,000,000 yen or dollars, and in 1893, 88,000,000. The values of the exports were respectively 28,000,000 and 90,000,000. The principal articles of import are cottons, sugar, woollens, beverages, machinery, and petroleum, and of the exports silk and cocoons, silk tissues, rice, tea, copper, porcelain, coal, and preserved fish. Of the different countries trading with Japan, the United States took the largest amount of Japanese goods in 1893, then followed in their order of importance Great Britain, France, Hong-kong, China, British India, and Germany.

As regards imports into Japan the order is as follows:—Great Britain, China, India, Germany, and the United States. In the carrying trade of Japan, Great Britain holds a marked prominence, the value of goods carried in British steamers in 1893 being 99,000,000 dollars, as compared with 21,000,000 in French steamers, 23,000,000 in German, and 13,000,000 in Japanese steamers. The internal means of transport have exhibited a marked development in recent years. In 1892 there were 1,700 miles of railway line open, and in March, 1893, the total mileage of all railways in operation was 1,877 miles. Of this extent 557 miles are Government lines, averaging a cost of 61,000 dollars a mile. Private railways were commenced in 1888, and much attention was devoted to them until 1892, when financial reasons intervened and enterprise in this direction suffered a check.

Towards the end of 1893, however, some sixty applications were under consideration by the Railway Council who, according to Japanese journals, are somewhat perplexed how to deal with these numerous schemes. The total mileage of private lines is about 1,400 miles, representing a capital of 56,000,000 dollars. Her Majesty's Consul for Hiogo and Osaka says, that with the lines already sanctioned and those likely to be sanctioned, Japan will, within the next twenty or thirty years, have an extent of about 4,600 miles of railway. The average profit on Government lines is rather more than per 6 cent.;

that of private lines slightly in excess of 5 per cent. One feature of railway enterprise in Japan is in the near future, an elevated line in Tokio. While on the subject of railways it may not be out of place to state that there is a prospect of some practical steps being taken in the direction of increasing the speed on all railways, particularly on the Koba-Tokio trunk line, 376 miles in extent. On this line the journey takes over nineteen hours, the average speed being less than twenty miles per hour. An important railway project affecting the central portion of the empire is said to be on foot, and the original scheme of connecting Tokio and Osaka, *viâ* what is known as the "Nakasendo," seems likely to be revived. The proposed line will run through important timber, silk, cereals, porcelain, woven fabrics, and lacquer-producing districts. The total length will be 338 miles, and the cost is estimated at 21,000,000 dollars. Leading Japanese newspapers record that there are present in Japan 1,006 joint stock companies with an aggregate capital of 102,000,000 dollars; 131 national banks with 48,000,000 dollars capital; and sundry railways with a total capital of 73,000,000 dollars. Fourteen new life assurance companies were started in the empire during 1893. In connection with life insurance in Japan, a curious statement is made by Consul Enslie to the effect, that on an average out of every three persons who insure their lives one fails to keep up the policy.

There are eleven electric light companies with a paid-up aggregate amount of 1,674,000 dollars out of a nominal capital representing 2,477,000 dollars. According to returns made by the Japanese Home Department, the total number of periodicals and newspapers published in the country was 972. Of these 228 were devoted to current topics and events; 11 to law, politics, and political economy; 69 were religious organs; 251 were devoted to education and fiction; 40 were supported by the medical profession; 167 treated of agricultural, commercial, and industrial matters; and 26 were utilised for Government notices. During 1892 a total of 244,203,066 issues of newspapers and magazines were printed, or 163 per diem for every 10,000 of the population; 460 new journals were brought into being, 434 ceased publication, and 87 were suspended. Tokio heads the list with 203 newspapers and magazines, Osaka coming next with 57, Kioto stands third with 46. Kanayawa prefecture only possesses 11 papers and magazines, as the majority of the people subscribe to the Tokio papers. Of prefectures, that of Hiogo publishes the greatest number, namely, 36; Iwate has the fewest, only two. The number of newspapers and magazines published in 1890 was 716, and in 1891, 766. The latest report published by the Department of Education shows that at the end of 1892 the total number of children on the school rolls throughout Japan was 7,356,724, and that of these 497,106 boys and 1,584,079 girls were unable to attend owing to a want of the necessary funds for school fees.

Correspondence.

BRITISH FORESTRY.

Mr. JOHN ROBINSON, M.Inst.C.E. (Westwood-hall, Leek), writes:—I have read with very great interest the copy of a letter of "A Botanist" on British Forestry, addressed to *The Times* and inserted in the *Journal* of August 31. The writer has most judiciously taken into account the economic, the climatic, as well as the picturesque aspects of the question, all of which are of the highest importance to our imperial and colonial interests. I am not able to say what progress has been made in the direction of arboricultural study in the University of Edinburgh since a chair was established there for the promotion of that science, but unhappily I see but little progress throughout our own country in the direction of scientific tree cultivation. A recent issue of a new edition of "Aboriculture," by that veteran in the practice of the subject, Mr. Grigor, of Forbes, has inspired me with hope that some interest is being aroused in the subject such as you will remember we long ago endeavoured to stir up in the country, though the lethargy of landed proprietors and want of knowledge on the part of many of their agents have rendered progress painfully slow. In reference to the climatic branch of the question, it may be well to say that when the Floods Prevention Bill was before the House of Commons it was suggested to a member of the then Government, who is also a member of the present administration, that a clause might well be inserted giving power to the several authorities to acquire and plant land for the purpose of retaining the rainfall on our higher, and, at present, sadly bare hillsides, and thus not only help to prevent floods, but also give shelter to the neighbouring districts. All such effort has hitherto been vain, but some of the veterans in the struggle may, like myself, take heart in view of the excellent letter to which I have referred, and which all of us who are interested in the question will regard as a hopeful "sign of the times."

Obituary.

ADMIRAL SIR EDWARD AUGUSTUS INGLEYFIELD, K.C.B., D.C.L., F.R.S.—Sir Edward Inglefield, whose death took place on Wednesday, September 5th, was a member of the Society of Arts from 1869 to 1871, and from 1881 to 1889. He served on the Council in 1871, and from 1881 to 1883. He entered the navy in 1832, and served during the Syrian war at the bombardment of St. Jean d'Acre and the capture of Beyrout. Later on he was employed in surveying work in China and Borneo, and elsewhere, and in 1855 he commanded the *Firebrand*

in the Crimean war. His best known work, however, was connected with Arctic exploration. He commanded a private expedition in search of Sir John Franklin, and in 1853 and 1854 he was in command of two expeditions sent out to relieve Sir Edward Belcher. His Arctic services led to his election as a Fellow of the Royal Society. He was made a C.B. in 1869, and knighted in 1877. In 1887 he was made a K.C.B.

PROFESSOR HERMANN LOUIS VON HELMHOLTZ.—Professor von Helmholtz, to whom the Albert Medal of the Society was awarded in 1888, “in recognition of the value of his researches in various branches of science, and of their practical results upon music, painting, and the useful arts,” died at Charlottenberg on the 8th inst. He was born in 1821, at Potsdam. He commenced his career as an army surgeon, but he early left this work for university teaching. He held various professorships at Königsberg, Bonn, Heidelberg, and Berlin; in the University of which last-mentioned city he held the post of Professor of Natural Philosophy at the time of his death. His most important works dealt with the Conservation of Energy, Physiological Optics, and the Sensations of Tone, which last work was translated into English by Mr. Alexander Ellis. His principal characteristic may be said to have been the wide range of his scientific knowledge, for he was eminent equally in physiology and in physics. In the catalogue of the Royal Society he is credited with more than a hundred papers, and until quite recently he was engaged in the active work of research.

General Notes.

KIOTO EXHIBITION.—The fourth internal exhibition of industry organised by the Japanese Government, it is announced, will be held at Kioto from April 1st to July 31st, 1895. The exhibits will be included under the following classes:—Manufactures, Fine Arts, Agriculture, Waste Products, Education, Mines and Mining, and Machinery.

ANTWERP FOOD CONGRESS.—The Secretary of the Society has received from the Science and Art Department a programme of the International Food Congress, which is to be opened at Antwerp tomorrow, the 15th inst. The Congress is divided into six sections:—Agricultural, Commercial, Industrial, Legislative, Scientific, and Social; and the subjects proposed for discussion are classed under six corresponding heads.

LONDON COUNTY COUNCIL.—The report of the Technical Education Board (London County Council) on the Examination for Intermediate County Scholarships, held in June last, has been published, from which it appears that there were 348 candidates, of whom 148 were girls. Of these, 12 failed to present

themselves, and of the remainder 185 satisfied the examiners in the preliminary subjects, and were permitted to take the remainder of the examinations. The number of printed papers of questions set for examination was 32. Thirty-five boys and 15 girls were awarded intermediate county scholarships in July as the result of the examinations.

CAIRO MUSEUM.—Her Majesty's Secretary of State for Foreign Affairs has received a copy of the Supplement to the Egyptian “Journal Officiel” containing a statement of the conditions under which architects are invited to compete for the prizes—amounting in all to £ E 1,000—offered for the best and four next best designs for the new Museum of Antiquities at Cairo. This copy of the programme can be seen at the Commercial Department of the Foreign-office, London, between the hours of 11 a.m. and 6 p.m. It is hoped that additional copies of the programme will shortly be at the disposal of persons who may decide to compete.

EXTINCTION OF THE SOUTHERN FUR SEAL.—Mr. F. R. Chapman contributes to the *Canadian Record of Science* some data regarding the virtual extermination of the fur seal from the coasts of New Zealand and Tasmania. The millions of seals which formerly inhabited those regions have so far diminished in numbers that the animal is all but unknown to the existing population. On the southern coast of New Zealand, prior to 1825, seals were so abundant that in a single season shore-parties secured as many as one hundred thousand skins; at the present time, it is said, that not a seal is to be seen in those tracts sometimes for a period of ten years. The waters of the Snares, Auckland, Campbell, and Macquarie Islands have been similarly depleted. It is claimed that this rapid extermination is due primarily to reckless slaughtering, a condition analogous to that which obtained until recent years, and still obtains to an extent, along the Newfoundland coast.

AMERICAN WEATHER REPORTING.—With 3,000 voluntary observers taking observations of temperature and rainfall, and recording miscellaneous meteorological phenomena, it is now possible to supply, through the National Weather Service, climatological information for almost every county in the United States. Nearly every county in that country is provided with a station equipped with instruments of the Government standards. Should the work of establishing new stations proceed during the next two years at the same rate as during the past two, there will not be a county in the States that will not have a meteorological station. More than 10,000 crop correspondents are, it appears, at present co-operating with the National Weather Service through the State organisations; 3,000 voluntary observers are furnishing monthly reports of daily observations of temperature and rainfall; and over 11,000 persons assist in the work of distributing the weather forecasts of the National Weather Service.—*Times*.

Journal of the Society of Arts.

No. 2, 183. VOL. XLII.

FRIDAY, SEPTEMBER 21, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

PRIZES FOR DESIGNS FOR FURNITURE.

The Council of the Society of Arts hold a sum of £400, the balance of the subscriptions to the Owen Jones Memorial Fund, presented to them by the Memorial Committee, on condition of their spending the interest thereof in prizes to "Students of the Schools of Art, who in annual competition produce the best designs for household furniture, carpets, wall-papers, and hangings, damasks, chintzes, &c., regulated by the principles laid down by Owen Jones."

The prizes will be awarded on the results of the annual competition of the Science and Art Department. Competing designs must be marked "In competition for the Owen Jones Prizes."

No candidate who has gained one of the above prizes can again take part in the competition.

The next award will be made in 1895, when six prizes are offered for competition, each prize to consist of a bound copy of Owen Jones' "Principles of Design," and the Society's Bronze Medal.

Proceedings of the Society.

CANTOR LECTURES.

TYPE-WRITING MACHINES.

BY HENRY CHARLES JENKINS,
A.M.Inst.C.E.

[THE RIGHT OF REPRODUCING THESE LECTURES IS RESERVED].

Lecture I.—Delivered April 30, 1894.

The subject before us to-night occupies a somewhat peculiar position, in that, although possessing much importance and interest, it

is but a development in a particular direction of something much greater. It is generally agreed that the most wide-reaching invention in the present era has been that of printing. Until about five centuries ago, the records of the world, and duplicate copies of them, were, with very few exceptions, all obtained by means of the laborious operation of writing. The exceptions were to be found in the use of engraved seals, which could be impressed upon the surface of a plastic material that subsequently could be hardened, and in the use of engraved wooden blocks, from which an ink impression could be made upon a sheet of paper. The use of the wooden blocks was, however, confined to a single part of the world, and for the rest, the scribe had not only to make the first, but every other copy of his work.

The invention and use of moveable types created what was nothing short of a social revolution, the beneficial effect, and even the residual agitation of which we feel at the present day. It must have occurred to many a printer since that time that the use of a set of types for the production of a first copy, without the need of "composing," would be advantageous; indeed, the bookbinders of to-day perform wonderful feats in lettering by such aid. It would ultimately be the opinion of some one versed in the mechanical arts, that the operation could be performed by a suitable machine; and we find that, in 1714, a Mr. Mills—born in London in 1680—and at that time engineer in chief to the New River Water Company, devised some such machine, and obtained letters patent for it. He seems never to have developed his invention; indeed, his duties would probably leave him little leisure, and the "typewriter" was left for a later day.

There are a few fragmentary records of machines that may have been typewriters, including those of an embossing machine, invented in France in 1784; but we have nothing very definite until nearly a century and a half had elapsed.

In the year 1844,* the Rev. W. Taylor, F.R.S., exhibited at the meeting of the British Association, at York, a type-writing machine, the invention of Mr. Littledale, a resident of that city. It was designed for the especial purpose of giving aid to the blind. It is possible that earlier attempts may still be discovered, for ever since the beginning of this

* British Assoc. Report, York meeting, 1844, p. 99

century, and for long previously, benevolent minds had been hard at work to ameliorate the condition of those who are not so fortunate as to enjoy the possession of sight, and it is difficult to suppose that a half century had been occupied with inventions by which to aid them in writing and in reading, without some such attempts having been made. No drawings of this machine are to be found, but we have a description indicating that the apparatus consisted of a set of types arranged in a single row, and means by which any one of the set could be brought beneath a hammer. There was also some arrangement by which a sheet of paper was held in place beneath the hammer and moved the width of a letter at every stroke of the machine. Finally, although Mr. Littledale endeavoured to produce embossed printing, he also employed blackened or "manifolding" paper, which, placed between the hammer and the sheet, caused a black mark to be left upon the embossed sheet. Wooden type was employed, and to avoid damage to its face the inventor of the machine used a piece of cloth between the type and the impressing hammer. He contemplated, however, the use of metal type.

It will thus be evident that Mr. Littledale's machine was a veritable typewriter, which we may, for all ordinary purposes, define as being a machine for producing printed matter without the preliminary "setting up" of type.

All the practical typewriters of the present day are printing machines, but they need not necessarily be so, we might have true writing machines, or we could have stencilling machines.* Many present will recall the late Professor Cowper's arrangement of cams, by which two motions, at right angles to each other, could be given simultaneously to a pencil, and thus cause the pencil to trace out written letters.

The following figure (Fig. 1, p. 841) shows a machine in which a similar attempt, but on a much bolder scale, was made. This machine was patented in this country in 1846 (No. 11492) by Vickers, of Sheffield, as a communication from a foreigner residing abroad. Fig. 1 is from the patent specification, and, as it has been a little simplified for the sake of clearness, only shows the arrangements for writing three letters of the alphabet instead of twenty-six letters, besides figures. There is a shaft, *a*, upon which is mounted a series of cams, one set of which is lettered *b*. A similar set is

provided for every letter that the machine is adapted to write. The set of cams consists of two surfaces, one of which is what is technically known as a "face" cam giving motion, in the direction of the axis of the shaft, *a*, to a piece, *d*, attached to a sliding frame carrying the pencil, *e*. The other part of the set of cams consists of a surface, giving motion in the vertical direction to the piece, *c*, upon which the horizontally sliding piece, *d*, is mounted. The pencil, *e*, is thus made to partake of both movements, and by giving suitable shapes to these two surfaces the movements of the pencil, due to one revolution of the set of cams, correspond to that necessary to form a single letter upon the temporarily fixed sheet of paper, *g*. The pencil, *e*, is also pivotted on the frame that carries it, so that it is only in actual contact with the paper when writing is being performed. There are several ways in which the revolution of the cams may be brought about, either a lever, *f*, may, by its depression, cause the rotation of the system by means of a cord wrapped around a drum, *h*, mounted upon the same shaft as the cams, and engaging with them in one direction only, by means of a suitable arrangement of ratchets; or the shaft may be kept continually rotating by independent means, and the cams brought into connection with it for the period of one revolution at a time, by means of some suitable clutch contained in drum, *h*, whenever the lever, *f*, is depressed. The inventor provides in the patent for the adoption of either method, but illustrates the latter.

We now will consider a notable feature in the machine, in which it was much in advance of many later and, in all other respects, better instruments—its writing was properly spaced.

The paper was held in its flat frame immediately opposite the pencils, and this frame was capable of sliding vertically in a second frame, *l*. The frame, *l*, could, moreover, slide longitudinally in between the guides, *m m*. A rod, *n*, was provided parallel to *m m*, and, allowed a screw, or worm, mounted on the back of *l*, to slide over it, but compelled the worm to partake of its rotatory motion. This rod was connected also, by means of a train of wheels and a cord, with the treadle, *k*. The treadle, which was mounted on two pivotted arms, extended right along the machine, and rested beneath the levers, *f*, so that whenever one of these was depressed, the bar, *k*, was also depressed a pre-arranged distance, varying with the width of the letter to be written, and adjusted by means of a set screw on *f*.

* Very few stencilling machines have been made. One was patented by Forbes (3235, of 1876) of England.

This caused the rod, *n*, and the worm to rotate and advance the paper the proper distance for the letter to be written at the same time as cams were thrown into gear. The same movement also advanced the point of the pencil up to the paper, and writing would commence.

The treadle, *k*, would rise as soon as the lever, *f*, was liberated, but would not affect the position of the paper, owing to the interpolation of a suitable ratchet in the train of wheels. Then when the shaft, *a*, had completed its revolution, the pencil, *e*, would drop

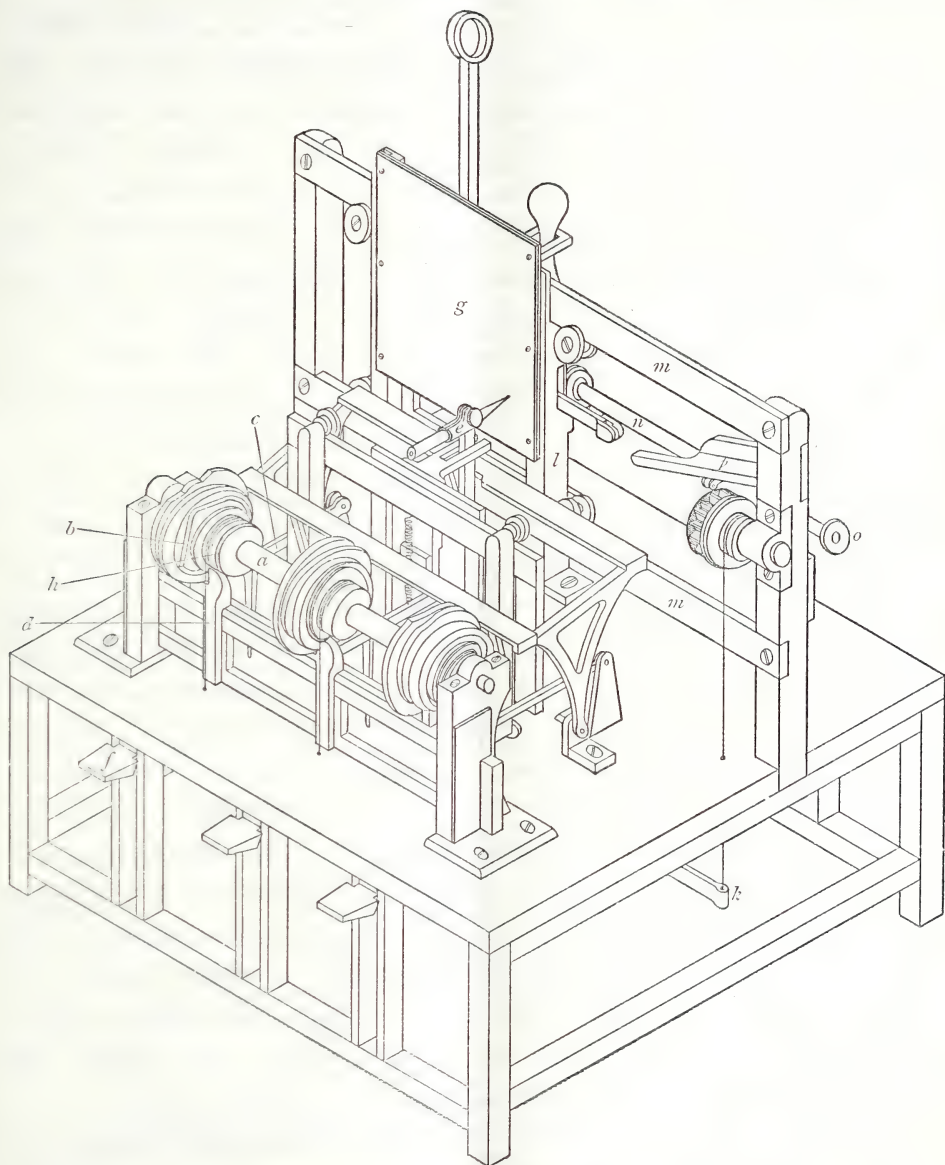


FIG. 1.—VICKERS' SPECIFICATION, 1846.

away from the paper, and at the same time the cams, *b*, would drop out of gear, and everything would be ready for the writing of another character. At the end of the line the shaft, *n*, and the treadle, *k*, were disconnected by means of a catch, *p*, and the shaft rotated

backwards by means of a milled head, *o*, this also caused the sheet, *g*, to be lifted up the distance of a line in the frame, *l*. The catch, *p*, was replaced, and writing could be recommenced. The means employed for the adjustment of the spaces that each letter

NORWICH 3. FEBRUARY 1846

CENT.

WE HAVE, AT LENGTH COMPLETED ONE OF THURBERS MECHANICAL CHIROGRAPHERS. ALTHOUGH YOU WILL NOTICE IMPERFECTIONS IN THE FORMATION OF THE LETTERS IN THIS COMMUNICATION, YET THERE IS NOT A SINGLE DEFECT WHICH DOES NOT ADMIT OF AN EASY AND PERFECT REMEDY. I AM PERFECTLY SATISFIED WITH IT BECAUSE I DID NOT LOOK FOR PERFECTION IN THIS FIRST MACHINE. THE DIFFICULTY IN THIS MACHINE IS THAT THE CAMS ARE NOT LARGE ENOUGH. THIS, OF COURSE, CAN BE AVOIDED. I THINK MR. KELLAR TOLD WHEN I LAST SAW HIM THAT IF I WOULD WRITE TO HIM INFORMING HIM WHEN I SHOULD BE IN WASHINGTON HE MIGHT BE ABLE TO MAKE SOME SUGGESTIONS ABOUT A HOME DURING MY STAY IN WASHINGTON. I SHALL WISH TO EXHIBIT THE MACHINE TO SUCH GENTLEMEN AS MIGHT TAKE INTEREST IN A THING OF THIS ~~KIND~~ KIND. I DO NOT WISH TO MAKE A PUBLIC SHOW OF MYSELF OR MY MACHINE. I WANT TO SHOW IT TO MEN WHO CAN APPRECIATE AND UNDERSTAND MACHINERY. MR. ROCKWELL, OUR REPRESENTATIVE IN CONGRESS VOLUNTEERED TO GET ME A ROOM & I HAVE WRITTEN TO HIM ON THE SUBJECT. STILL I THOUGHT IN CONSEQUENCE OF YOUR MORE THOROUGH ACQUAINTANCE IN THE CITY THAT YOU MIGHT BE ABLE TO MAKE SOME SUGGESTIONS WHICH MIGHT BE BENEFICIAL TO ME IN EXHIBITING THE MACHINE. I WANT A ROOM LARGE ENOUGH TO RECEIVE SUCH COMPANY AS MAY WISH TO SEE THE MACHINE. I WANT A ROOM WHERE I CAN SAFELY LEAVE IT WHEN I AM ABSENT AND WHERE NO ONE WOULD BE LIABLE TO GO IN AND INJURE IT. EXCUSE THE LIBERTY I HAVE TAKEN, AND BELIEVE ME

YOURS, TRULY. CHARLES THURBER.

MESSRS. KELLER & GREENOUGH
PATENT ATTORNEYS.

WASHINGTON, D. C.

should occupy, are open to criticism, they were very faulty, but the end sought to be attained was excellent, and it was many years before better means was provided. In the meantime we have almost become accustomed to the hideous uniformity of width of character (whether w, or a, or i, or m), imposed on us by the earlier marketable machines, but fortunately now no longer necessary, as will subsequently be seen.

This machine of Newton's so nearly resembles a writing-machine patented in the United States, in 1845, by Thurber, of Worcester, Mass. (No. 4271), that it has been described at length somewhat out of its place. A drawing is not preserved in the records we have in this country of the early American patents, but an examination of Thurber's claims lead to the conviction that his machine is identical with Newton's. We have fair proof, moreover, that the machine was made, as Fig. 2 will show. This has been photographed from what is evidently a lithograph* of writing actually produced in the machine itself, and we owe this cut to the courtesy of Mr. Allison, the librarian of our own Patent-office, in whose custody the sheet is to be found.

The sheet tells its own tale to the mechanical expert—a tale of difficulty that can only be appreciated by one who has experience with novel and intricate machinery. Indeed, this type of machine can hardly be imagined to have any chance of competing even with the pen, whether as regards permanent legibility or speed, the slightest irregularity of its working parts being quite enough to spoil either quality. There are easier ways, moreover, of getting legible writing that, at the same time, are but little affected by wear. In this machine it will be noticed that two distinct operations were found to be necessary to get one written character. One of these operations was the movement of a shaft, *a*, and the second was the depression of the key, *f*. This is slow, if performed by the operator himself, but in the course of this lecture we shall see that one of a pair of such movements may be performed automatically, and the combination utilised to great advantage.

Dronin† says of Thurber's machine:—"It did not answer well, because it had not the perfection that was necessary to enable it to obtain an advantage over the pen." The machine was, in reality, much in advance of the state of the mechanical arts of the time.

The next machine to which we will direct our attention possesses unusual interest. It was designed for the use of the blind by a man who was blind himself. Pierre Foucault, the inventor, was a pupil of the Institution for the Blind, Paris, and had so far finished his machine in 1849 that he was able to exhibit it in Paris, and receive for it the award of a gold medal. His invention was so useful that, in 1850, the Board of Encouragement, Paris, also awarded him a medal. He brought the machine to London in 1851, to the Great Exhibition, and obtained another award.* A number of these machines appear to have been made; they cost about £20 each. As they were somewhat bulky, they were placed on a low stool, in front of which the operator stood. The Fig. 3 is taken from a view published in London at that time; K is a curved keyboard with two rows of keys. Each key is attached to one end of a slider that was fitted

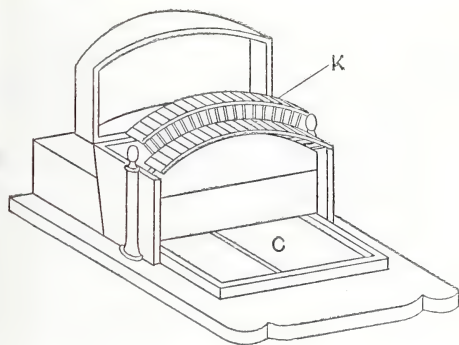


FIG. 3.—FOUCAULT'S MACHINE, 1850.

into one of a number of radial grooves in the machine. The opposite end of the slider carried a matrix that agreed with the key, and at the surface of the sheet of paper, *c*, the radial grooves all meet, and coincided, so that pressure upon any one of the keys would produce an embossed letter on the paper at one particular point. Means were provided by which the paper was advanced a step at every letter, and by which the paper could be shifted as required.

The jurors of the 1851 Exhibition had two other typographs to attract their attention, and they awarded medals to both.* One of the two machines, the invention of an Austrian named Marchesi, has disappeared; the other, which the jurors report to be the best in the Exhibition, is still with us. It is the invention of William Hughes, the governor of the Man-

* U.S. Patent-office Reports, vol. ix., 1845, p. 1,351.

† "Machines à Ecrire." Paris: 1890, p. 7.

* "Official Report Exhibition of 1851," p. 311; Cassell's "Illustrated Exhibitor." London: 1851, p. 53.

chester Blind Asylum, and one of the machines (Fig. 4) may still be seen in the magnificent collection of industrial machinery and models at South Kensington Museum. It is in working order, and the illustrations of it, as well as of several other of the historical machines, are from photographs, for which I am indebted to the able and courteous superintendent of that department, Mr. Last. There is a good description of the machine in the Official Report of the Jurors,* from which we might reconstruct the very simple piece of apparatus. It consists of a horizontal type-wheel, containing a number of vertical grooves in each of which is fitted a sliding type-bar, provided with a spring to keep it in its uppermost position. The type-wheel was provided with a wide rim that served as a dial-plate, and

around this rim a row of raised letters, was placed, each corresponding to a type-bar, so that with the forefinger of the right hand the operator could feel which letter was to be pointed. With the left hand the operator then depressed a lever, *d*, that both locked the type-wheel into position, and pressed down the sliding type-bar on to a sheet of paper beneath it. Then upon raising the lever a detent moved the wheel, *e*, the space of a tooth, and this carried the type-wheel, and all attached to it, the space of one letter along the fixed screw, *f*. The detent could be released at the end of each line and the wheel pulled backwards, so as to start a fresh one. The paper was placed in a "manifolding" book so that the writing was not embossed but in black and white only, and the frame carrying the book could be

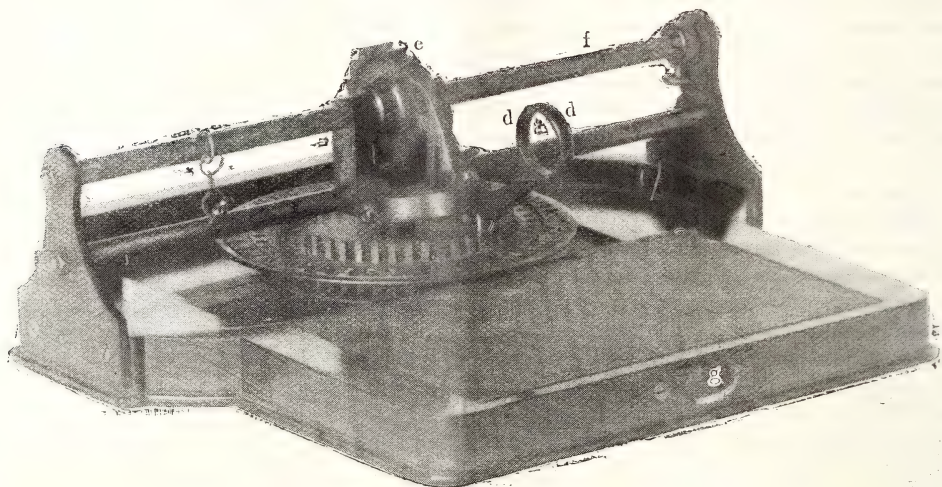


FIG. 4.—HUGHES' MACHINE, 1851.

advanced the space of a line, when required, by turning the screw-head seen in front of the machine at *g*. Hughes distinctly saw that his machine was capable of being applied to wider uses, and mentions the pointing of museum labels where neatness was desirable, as being a possible means of employment for it. But the public in general appear to have viewed these typographers, as they were called, in a most apathetic way, and severely left them to the use of those for whom they were primarily designed. Indeed, the official reporter, Mr. J. Glaisher, F.R.S., when giving his lecture in this room†, upon philosophical instruments (in which class these

machines were placed) at the Exhibition, did not even refer to them, although they had received medals by his award. But Hughes's machine was of too useful a nature to be ignored by inventors, and we find that in 1852, only the next year, a patent* for a somewhat improved form was granted to a Mr. Jones. He retained the type-wheel with vertical type, but employed a cylinder beneath it upon which to secure the paper, and this seems to be the first time that the cylindrical impression surface is patented in connection with typewriters. About the "invention" itself, the "Official Examiner" is quite eloquent. He reports that "a patent was granted for a mechanical typographer by which, with the necessary

* "Official Report Exhibition of 1851," p. 311.

† "Lectures on the Results of the Great Exhibition of 1851," London, 1852, vol. i., p. 321.

* No. 8980, U.S.

practice to secure a skilful use of the machine, an author can print instead of writing his thoughts." One rather fears that his duties had kept him too closely occupied to have, at least, read the accounts of what was to be seen in Europe.

In 1854 a very simple and crude typographer was patented in America* by an inventor named Thomas. There was (Fig. 5) a type-wheel, T, with a horizontal axis carrying several rows of type, an aligning pin, P, by aid of which the roller is kept in position, and a cylinder, C, upon which the sheet of paper may be placed. This cylinder is mounted on a slide, F, by means of which the spaces between the lines may be made, and the cylinder itself is rotated a small amount after each letter. The ink is supplied by springs, M M, over which the type is first passed.

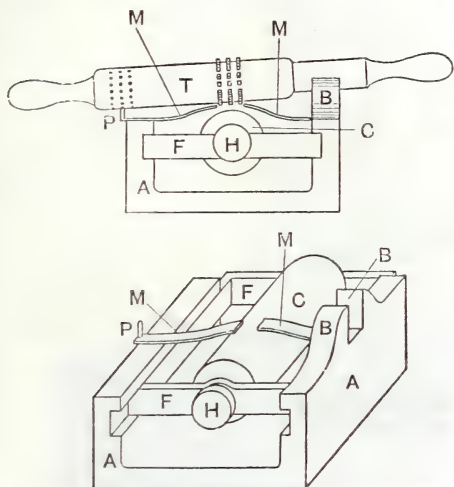


FIG. 5.—THOMAS' SPECIFICATION, 1854.

The printing machines with type-wheels in the above position are very numerous, but principally belong to the distinct class of printing telegraphs about which we are not concerned. The "Columbia" typewriter (1884) belonged however to this class, and reference will be made to it in the next lecture.

In 1856, another important combination was patented by an inventor named Cooper.† In this a wheel, with vertical axis and radial type was first brought into pointing position opposite a vertical sheet of paper; the wheel was then locked, and a hammer caused to strike the paper on to the type from behind. The

instrument had a dial-plate on the same axis as the type-wheel, by the aid of which a letter was selected, and the same handle that was employed for this purpose was employed to lock the wheel (as in Hughes's machine) and to cause the hammer to deliver its blow. This last was effected by fitting the hammer on a bellcrank lever, one arm of which passed immediately beneath the axis of the shaft upon which both type-wheel and index-plate were mounted. A depression of the shaft, to which the handle was attached, thus caused the hammer to give the impression. This machine is capable of much improvement, and, fitted with a keyboard, will be recognised in the course of next lecture.

We must now retrace our steps a little, for the problem of producing a practical typewriter had been engaging the attention of one of the greatest practical scientists of the day, as well as that of his assistants. The late Sir Charles Wheatstone had, in 1841, invented and patented a dial telegraph. He seems to have soon recognised the convenience that a machine-written message for delivery would be; and there is evidence to show that prior to 1850 he had constructed a working typewriter, in which a small square metal plate, or comb carrying the letter, was employed in conjunction with a hammer, by means of which a selected letter could be impressed on to a strip of paper. Although not publicly exhibited, he had one complete machine at the time of the 1851 Exhibition, and then he let the matter rest for a while. Afterwards he took it up again, and between the years 1855 to 1860 he had (with Mr. Pickler, of Buda Pesth) completed no less than six different machines, of which three remained in a complete form. Although they would not by any means meet the requirements of the present day, yet they are marvels of ingenuity, and are still in more or less working order. The existence of these machines has long been known to a few persons, and was, indeed, mentioned by Sir Henry Wood some years ago.* They are now in the South Kensington collection.

All three machines possess keyboards, and this feature, as well as that of the comb, gives them a special interest to us. Fig. 6 (p. 846) is taken from a photograph of the machine, which there is good evidence to believe to be the result of the first of the attempts already mentioned. The separate types are

* No. 10995, U.S.

† No. 14907, U.S., 1856; also Jones' Spec., No. 14919, U.S.

* *Journal of the Society of Arts*, 1888, vol. xxxvi, p. 354.

all mounted upon the teeth of a comb, *a*. This comb carrying the letters is at the top of the machine, and is a segment of a circle, the teeth being radial to a common centre, about which the comb is pivotted. A tiny hammer, *b*, moves in a

vertical plane above the comb, and over the printing point. Beneath the type-comb a segmental inking pad, *c*, covered with cloth, is made to vibrate as required; this at the printing of each letter dips into a well of ink, *d*, and passes between the face of the type

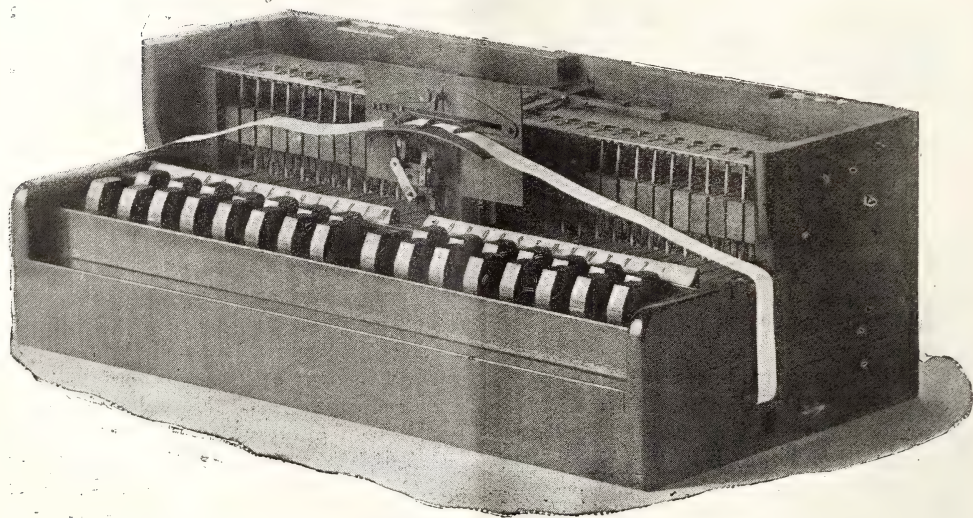
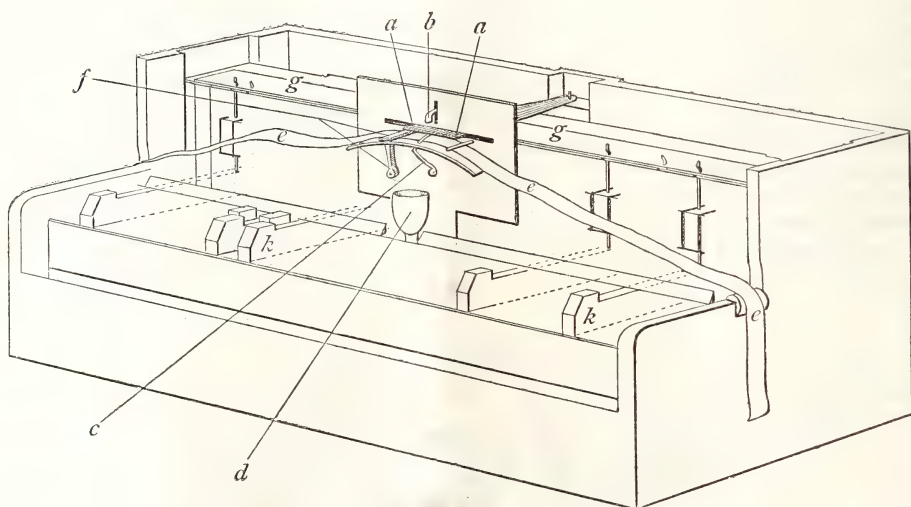


FIG. 6.—SIR C. WHEATSTONE'S EARLY MACHINE.

and the long strip of paper, *e*, upon which the matter was to be printed. It must be borne in mind, when looking at these instruments, that two springs, working in opposite ways against fixed stops, always bring the comb to a definite central position. If it be

desired to point the letter that then is immediately beneath the hammer, a key, such as *k*, is depressed; this causes the inking pad to be withdrawn, then the hammer to descend, imprinting the letter on the paper, and then, as the key rises, an ingenious friction grip, *f*,

through which the strip of paper passes, takes hold of the latter, and draws it forward through the space for a letter at the same time the inking pad returns.

It will generally be necessary to shift the teeth of the comb until the particular letter comes beneath the hammer. This is done by fitting each finger key with a stiff vertical

wire post (forming a right-angled lever with the key), and causing the top of this wire to lie in one of a series of slots made in a long horizontal metal plate extending right along the top of the instrument. This plate, *g*, is capable of sliding endwise, and is attached at the centre to the comb, whilst the slots in it are each so shaped as to just move the

k

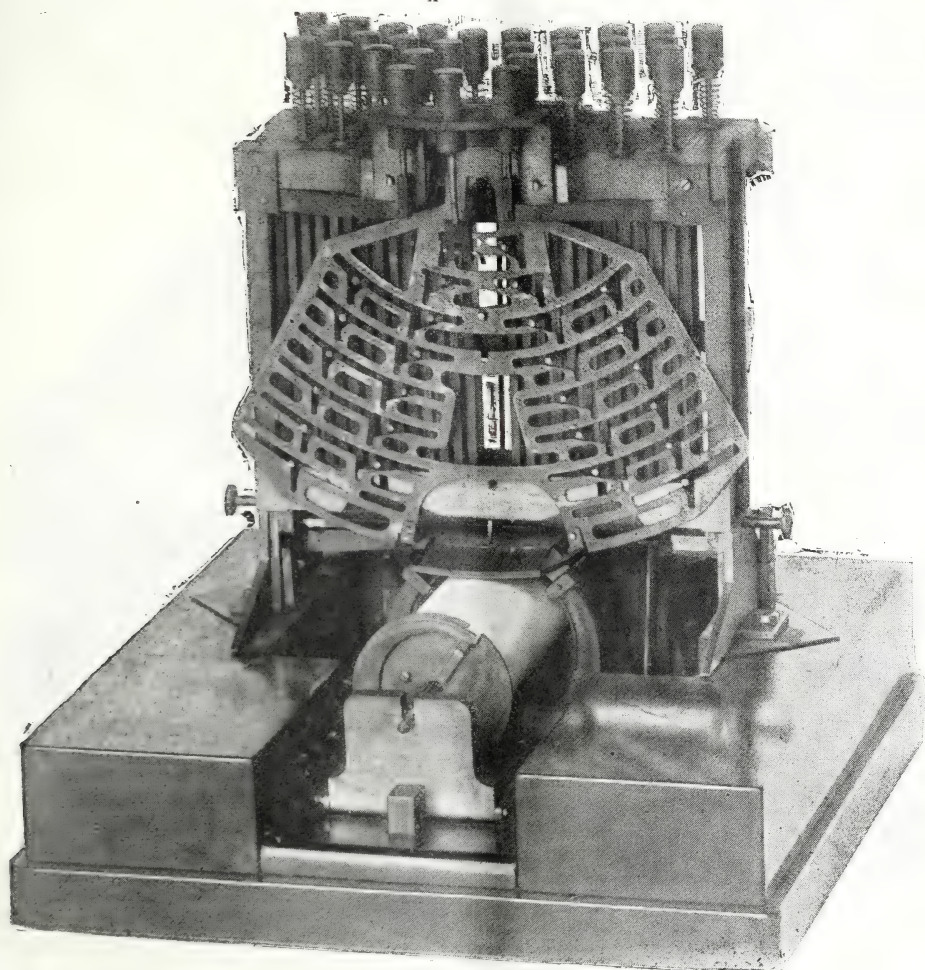


FIG. 7.—TYPEWRITER WITH "CHANGE OF CASE," BY SIR C. WHEATSTONE. SECOND PERIOD.

letter, corresponding to the key opposite the slot, into position under the hammer, when the key has nearly drawn its little post to its most forward position. The slot is then made so as to merely retain the comb in position whilst the hammer delivers its blow. This is a very simple method of connecting the keys with the type bars or "teeth;" but of course

the letters at either end of the keyboard require the comb to be moved through a very considerable angle, and Wheatstone was compelled to use rather small letters on this account. The slots, too, become rather inconvenient, and occupy a good deal of room, as they approach the ends of the keyboard.

Figs. 7 and 8 are the front and back view

respectively of the earlier of the machines made in his second attempts, and therefore about the year 1856. In this machine the comb is still retained, but becomes the surface of a part of a cylinder whose axis is the centre of the curiously shaped segmental plate (*g*), Fig. 7. This plate corresponds to the long plate in the earlier machine, and the mark-

ings in it are the cam grooves, by means of which the types can be swung into position. But by causing the keys controlling such letters as need the greatest amount of movement from the mid-position, to act upon the plate near the centre on which it is pivotted, Wheatstone was able to have the grooves much more nearly alike, and to be of a shape much more favour-

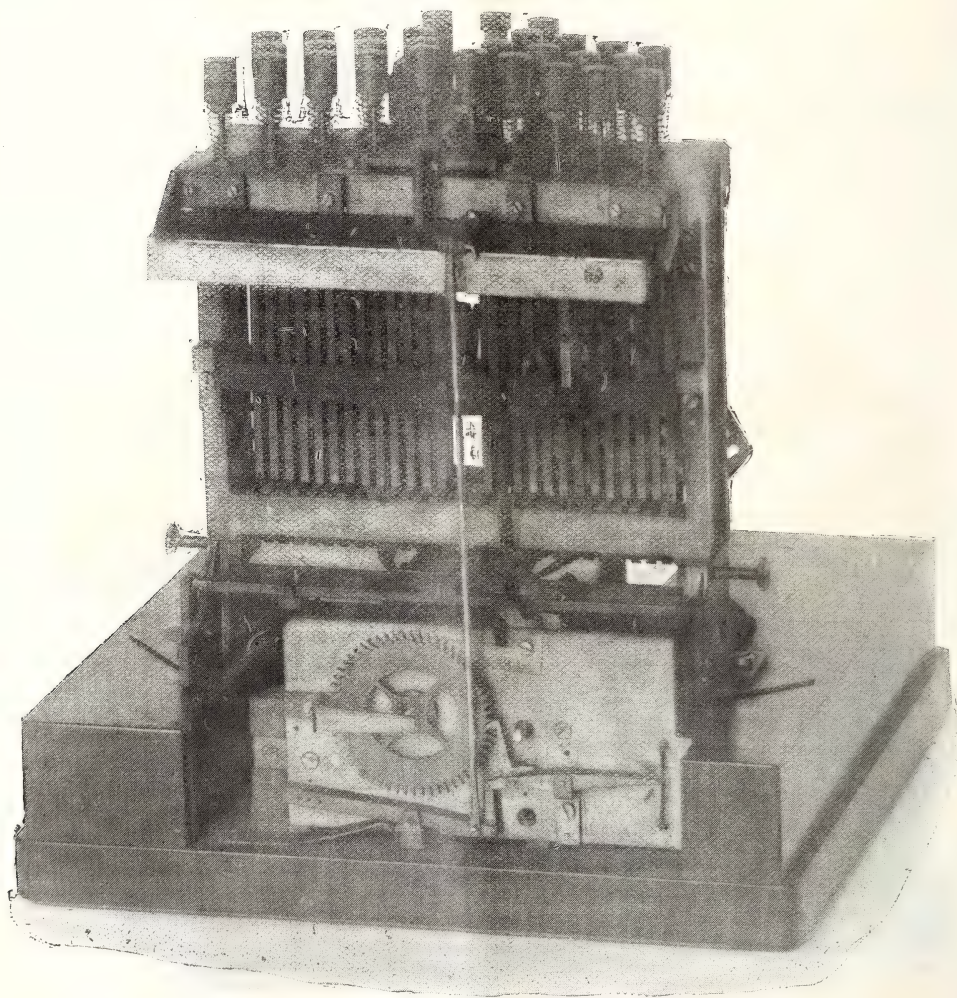


FIG. 8.—BACK VIEW OF WHEATSTONE'S TYPEWRITER.

able to smooth working. He had however to place his keys upon an elevated keyboard which was a distinct disadvantage. The keys, *k*, are upon vertical sliders, each carrying a small pin on its side that engages with its own proper cam groove in the swinging segment. But Wheatstone has also in this machine given us what is technically known as a change of

case, by mounting upon the same segmental plate a second comb and set of types that could be brought beneath the printing hammer of the machine by sliding the segment with the two sets of types a short distance along the axis upon which it swung, so that as one set was brought into position the other set was taken out. He provided a key by which this

change could be effected, and this most important convenience to the operator was re-invented in the early marketable machines and retained in use ever since.

The paper was first folded and then slipped upon a cylinder, the cylinder being first removed from the machine for that purpose. Each letter as it was printed caused the cylinder to revolve a given amount by means of a positive feed gear, and when one revolution was completed, a springy end to the cylinder that had been compressed between the teeth of a coarse rack during the revolution, caused the cylinder to slide along its axis the space equal to that of a line. This was

effected by providing an aperture, seen in Fig. 7, in the true end of the cylinder that allowed a tooth of the rack to pass when the latter was opposite the aperture. The rack itself was fixed and placed beneath, parallel to the axis of the cylinder. The ink was supplied to the type by means of a ring-shaped inking pad that completely encircled the paper roller, and which was slowly rotated by the action of the machine.

The third machine, Fig. 9 combined the good points of the other two already described. It had the "double case" of small and capital letters, with the small number of keys, and it had the cylindrical paper roller of the second



FIG. 9.—TYPEWRITER BY SIR C. WHEATSTONE. FINAL FORM. SECOND PERIOD. 1855-60.

machine with the convenient keyboard of the first. It is a very nicely finished and complete machine. The keys were, it must be confessed, somewhat heavy to manipulate, and the inking pad decidedly unsatisfactory, but in this respect no worse than machines made many years subsequently.

We must now look at what was being done in America at the same period in which Wheatstone was developing these machines, whose types were placed on separate springy bars, for such the teeth of his comb really were. A notable advance was in progress, for Beach, in 1856, patented* what appears to be the first

machine in which this idea was carried to its full development. He mounted each letter on a separate pivotted bar, or lever, and connected the levers to a keyboard by a series of links. The patent is crudely drawn, but shows pivotted levers carrying type, so arranged in circular fashion that they converge to a common centre or printing point, beneath which a strip of paper was passed by means of independent clockwork, the escapement of which, however, was controlled by a cord, that, passing beneath the type-bars, received a pull whenever one of the latter was depressed, and allowed the clockwork to advance the paper the space required on which to print the next letter.

* Spec. No. 15164. U.S., 1856.

A strip of "manifold" paper was also employed, just as Littledale used a sheet of the same substance, but Beach moved his strip in much the same manner as the well-known ribbon is now used. This method of supplying ink in a tissue through which the blow of the type was received has, on account of its suitability, never been superseded, indeed, the only improvement, so far, has been to substitute silk for the paper, and a moister ink, for although serious attempts have of recent years been made to substitute inking pads for the ribbon, the practice is confined to a few machines, and opinion is much divided as to the benefit derived, except in the case of type wheel machines.

But Beach went further, and finally constructed a complete if somewhat unwieldy machine, in which two levers, *a*, *b*, Fig. 10, were made to approach one another for every character, and emboss the paper strip that was fed between their respective type surfaces at every depression of the key, *k*. The two type surfaces fitted one another, so that work was produced in raised characters, and could be read by a blind person. It was, however, only on a strip of paper; indeed, it is difficult to see how this machine could work upon any other than a very narrow sheet. The machine is said to be still in existence.*

* "Scientific American Supplement," Jan. 1st, 1887, p. 9163.

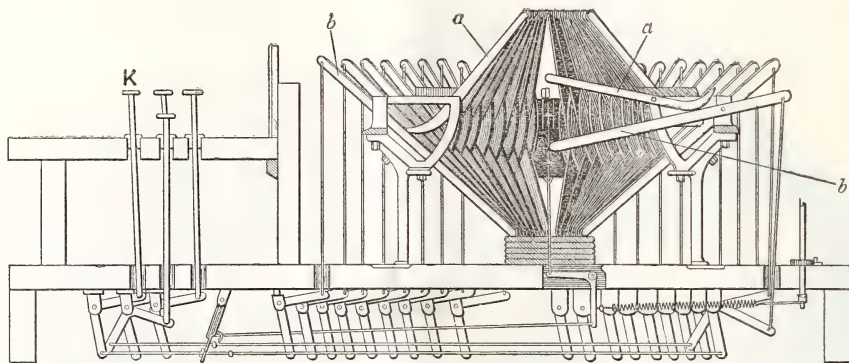


FIG. 10.—BEACH'S MACHINE.

Dr. Francis, of New York, appears to have been a very successful* worker of this same

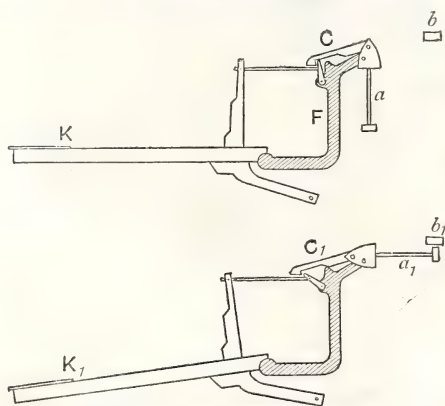


FIG. 11.—FRANCIS' MACHINE.

period. Like Wheatstone, he does not seem to have ever patented his invention, nor to

have attempted to bring it into commerce, but its mechanism was no doubt suggested by the ordinary piano action. He used pivotted and converging type-bars, *a*, but instead of connecting the keys, *k*, with the bars by ordinary links, he interposed a sort of trip gear, *c*, that raised the bars by the action of the keys against an anvil, *b*, beneath which the paper could be placed, so that the type-bar would be released, and could drop down again if *k* were depressed to the position, *k*₁, and forcibly kept from returning; *F* represents the framework of the machine. The action is ingenious, but, on the small scale demanded by the mechanism of a typewriter, is rather complicated: a trip gear to every lever is terrible to contemplate, although this would effectually prevent fouling of the type bars in skilful use. Evidently Dr. Francis' machine was of good size, like Foucault's, and what knowledge we possess of its details would indicate it to have been made in wood. He used silk ribbons, by which to supply the ink, and altogether his machine was a very complete example.‡

* "Scientific American Supplement," Jan. 1st, 1887, page 9162, where a section of Dr. Francis' machine is given. The figure 11 is simplified for the sake of clearness, the original machine having been constructed in wood.

One other worker, who believed in the commercial aspect of the typewriter, must here be mentioned: I refer to Thomas Hall, of New York. He tried many forms of machine, and was so successful with one as to have been

able, in 1861, to write 400 letters in a minute by its aid. These early attempts must not be confounded with the very simple little machine—now passing out of use—with which Hall's name is connected by the public; this latter

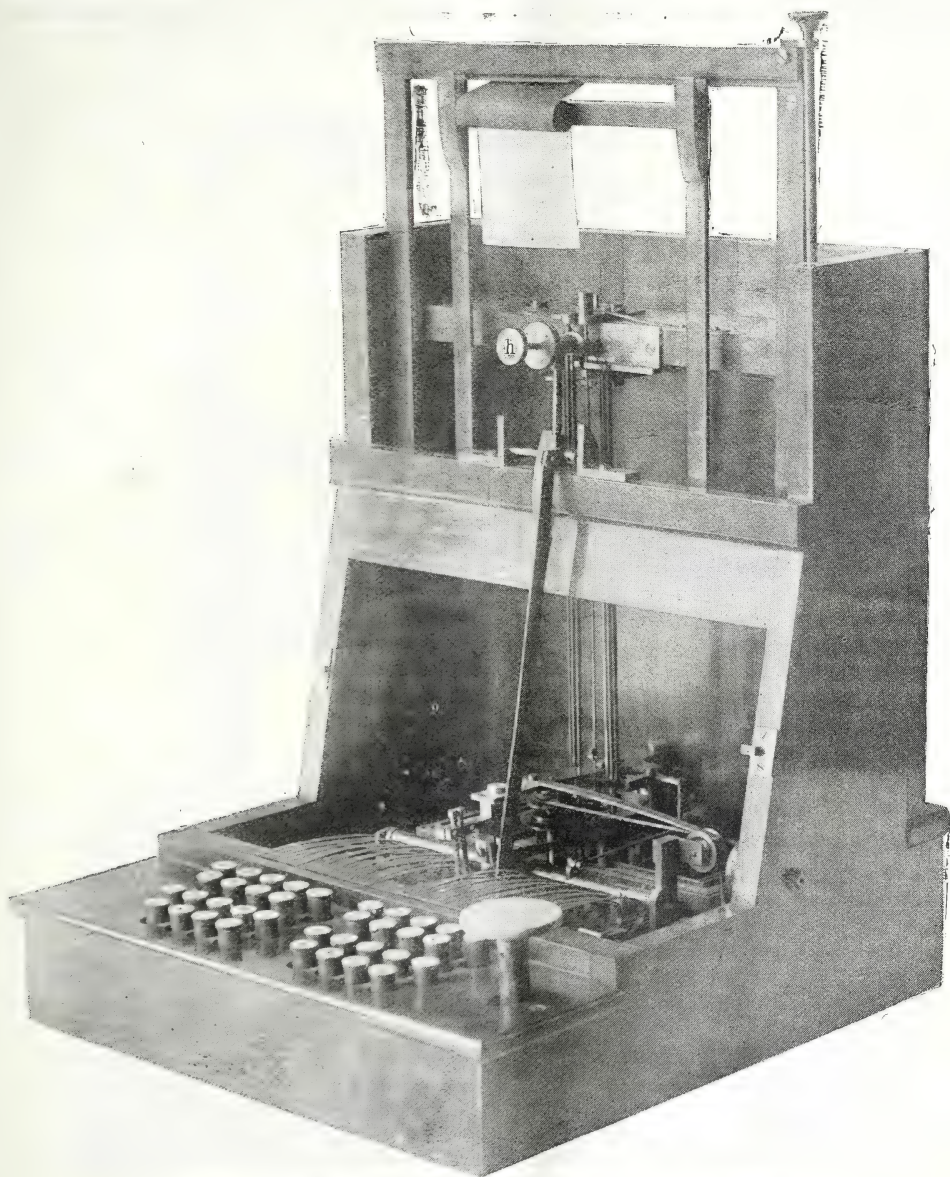


FIG. 12.—FINAL FORM OF PRATT'S MACHINE. FRONT VIEW.

belongs to a much later date, and met a want of the hour; a consideration of it belongs to our next lecture.

There is another historical machine, a short description of which will bring this lecture to a close. Pratt, an American inventor, of

Alabama, U.S., patented in this country, in 1866,* a machine that he afterwards exhibited at a Wednesday evening lecture in this room.†

* No. 3163, Dec. 1st, 1866.

† *Journal of the Society of Arts*, 1867, vol. xv. p. 384. The machine was illustrated in *Engineering*, 1867, vol. iii., p. 3

In this machine he employed a small plate of metal bearing the fount of letters arranged in rows upon it and placed behind a vertical sheet of paper. He adjusted this plate so as to bring any selected letter immediately behind a hammer that he had mounted in front of the paper and above the keyboard. The depres-

sion of any key of this board caused the plate to be adjusted, the hammer to strike its blow, and the paper to be subsequently shifted to afford space for the succeeding letter. The illustrations, Figs. 12 and 13, are from a later form of his machine, very greatly improved, and at present in the South Kensington collection ;

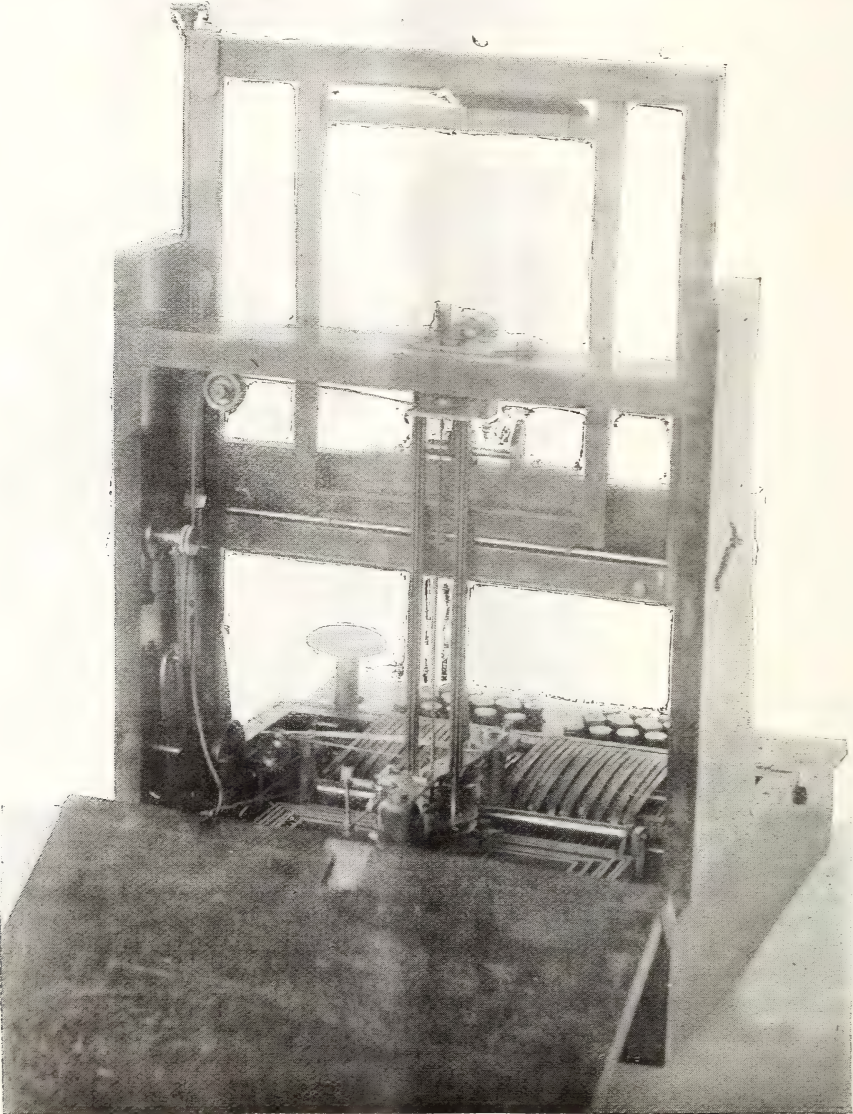


FIG. 13.—FINAL FORM OF PRATT'S MACHINE. BACK VIEW.

his earlier models appear to have been unfortunately lost to us. In it he retained the general form of his earlier machines, and the use of the hammer in front of the paper ; but instead of placing the types in a plate, he mounted them in three horizontal and twelve

vertical rows upon a small vertical type-wheel, placed immediately behind the hammer, *h*, Fig. 12.

This type-wheel is connected to a train of clockwork that always tends to rotate it, but is prevented from doing so by means of

a tooth mounted in a notched circular plate placed at the foot of the vertical shaft of the type-wheel. The shaft can thus be brought to rest at positions corresponding each to a single vertical row of letters by means of stops acting in the notched plate, and operated by the respective keys to which the letters belong. A second motion could also be given to the wheel in the direction of its axis, and thus the letter of any one of the three horizontal rows selected. Both these motions were controlled by one movement of the key, and the same movement, when continued, caused the hammer, *h*, to be struck. The return movement allowed a coiled spring, by the release of an escapement, to draw the paper carriage a step onwards for the next letter. There was a key, *m*, provided, by which the paper carrier was drawn back (and automatically lifted a line) so as to commence a new line; this action wound up the springs and clockwork employed to rotate the type-wheel and to advance the carriage. Pratt's machine was a practical and portable type-writer, and with it the experimental stage of type-writing machines as a class may be said to end.

Miscellaneous.

PRODUCTION OF MANGANESE ORE IN THE CAUCASUS.

The manganese ore industry of the district of Sharopan, in the government of Kutais, is one of the chief sources of Caucasian wealth. Consul Stevens, of Batoum, says that its significance even in its present early period of existence is a question of vital importance to the population of the government of Kutais, as also to the whole of the Russian Empire, for Russia, which annually furnishes over 150,000 tons of this ore to other European nations for the purpose of making steel, has become one of the largest exporting countries in the world. England takes more than half the quantity she requires for her foundries from the Caucasus, and is thus one of the largest consumers of this article. Many other first-rate European powers use considerable quantities of Trans-Caucasian manganese at their steel works. Within the last few years, the already existing large demand for this particular kind of ore has been increased, by the fact that America has likewise become a consumer, and there is every prospect that on the completion of the Chiatur branch of the Trans-Caucasian railway, a still further augmentation in the demand will take place. The manganese ore industry is also of importance to the population of

the government of Kutais, inasmuch as it furnishes labour for the more or less poverty-stricken inhabitants of that province, where the insufficiency of the lands allotted them and the unproductiveness of the soil are more seriously felt than in other parts of the Caucasus. The industry has, therefore, become a most important factor in the existence of the inhabitants, and during the last few years the population of Imeritia alone has earned over £150,000 per annum for working the mines and transporting the ore to the railway station of Kvirili. The ore is obtained exclusively in the district of Sharopan near the village of Chiatur, about twenty-six miles from the village of Kvirili, the administrative and commercial centre of the district. The great mass of the mines are situated in this locality, and they extend over an area of thirteen square miles. According to the latest estimate they contain 66,500,000 tons of ore, and it is calculated that at the present rate of activity it will take over 200 years to exhaust them. Mining was commenced in the year 1879, when 871 tons of ore were produced; in 1880, 4,081 tons were obtained, and five years later the quantity exported was 20,370. In 1889, 137,097 tons were exported, and in the present year (1893), after the completion of the construction of the railway it is expected that the exports will reach the high figure of 322,580 tons. The Chiatur manganese ore fields are situated in a very mountainous and difficult country following the course of the River Kvirili, at a height of from 700 feet to 1,050 feet above the village itself. The mines are distributed in groups about two to three miles distant from the village, and are connected with the latter by narrow cattle tracks which wind in zig-zags over rocky ground, vertically-placed precipices, and projecting rocks, where obstructions are frequently met with. Access to them is, therefore, rendered dangerous, and the ore has to be transported in small quantities at a time on the backs of horses. In wet weather, when these tracks become almost impassable, many accidents occur, both with man and beast, during the transit of the ore. The industry is, therefore, entirely dependent on the elements; and in the autumn of the year 1891, which was exceptionally wet, a sensible decline, as compared with the same period of the previous year, was observed in the quantities of ore brought down from the mines to the railway station of Kvirili. Other drawbacks are experienced in the conditions under which the manganese ore industry of the Caucasus is carried on. Five mountains rise in an almost perpendicular slope from the bed of the river Kvirili, three of which—namely, Sedorgani-Rgani, Gwimewi, and Darquetti, are situated on its right bank, and two, namely, Shukrutti and Perewissi, on the left—contain, at almost equal distances from the level of the river, a layer of manganese ore, of considerable depth, which is alternately found between layers of chalk, earth, and other substances. The three mountains on the right and the two on the left banks are detached from each other by rivulets,

which discharge their waters into the River Kvirili, and those slopes of the five mountains that are nearest to the village of Chiatur have been pierced by the mine owners. In extracting the ore, a perpendicular layer of soil on the slope of the mountain is first removed, and, together with the earth, stone, and manganese dust, obtained from tunnelling, a sufficiently spacious plateau, or unsupported embankment, is made, on which sheds are erected, and along which a road is constructed; subsequently, by means of a tunnel pierced through the side, the mountain is entered, and a horizontal gallery, from which the ore is obtained, is excavated. The interior of this gallery seldom reaches a greater depth than 35 feet, and only in extreme cases are pits of medium length to be found. The supports in the galleries are few and far between, and landslips in the mines are of frequent occurrence. The work in connection with the production of the ore is heavy; it is leased out to the miners by piecework, and paid for per cubic *sajen* of 22 tons of pure ore. The time required by four men to procure this quantity is about 20 days, and the price paid for the workmen, including their tools, lamps, oil, &c., is £4 per cubic *sajen* of 22 tons pure ore. The ore obtained in the Chiatur mines, when thoroughly well prepared, comprises from 54 to 55 per cent. of metallic contents, or 83 to 87 per cent. of peroxide, when dried at 212° Fahrenheit, and seldom more than 0.16 per cent. of phosphorus. This is the standard quality of the Chiatur ore, but it is brought down to 50 per cent. metallic contents by the admixture of an ore of inferior quality.

THE INDUSTRIES OF TONQUIN.

The principal articles of trade of the province of Ninh-Binh are rice, cotton, silk, and mats, in the exports, and wood, rattan, and salted fish, in the imports. The *Journal de la Chambre de Commerce de Constantinople* says that the province produces a large quantity of cotton, a portion of which is prepared and woven by the inhabitants, and the remainder purchased by the Chinese, and forwarded to Nam-Dinh, where it takes the Haiphong and Hong Kong route. A more important article of export at ordinary times is rice, and this trade is also in the hands of Chinese. Twice a year, at harvest time, the price of rice falls. The growers are all obliged to sell almost before the harvest is finished in order to pay the taxes and other liabilities, and to procure the necessities of life, and it is only with great difficulty that they manage to keep sufficient rice for their personal needs. Then the reserves are gradually exhausted, and prices increase gradually until the new crop is harvested. It thus becomes necessary to have recourse to foreign imports of rice, which are heavily burdened with customs duties and other charges, including those of transport and manipulation. There exist in the province of Ninh Binh only a few industries worthy of

the name. In a few villages there are rude looms for weaving silk and cotton. At Phat-Diêm and on the banks of the neighbouring streams there are places in which sampans and junks of plaited bamboo are turned out, and these are made of extreme lightness combined with great resisting power. They are capable, when of sufficient dimensions, of carrying very heavy cargoes. In the canton of Dong-Hai, which is adjacent to that of Kim-Son, the inhabitants make mats of rush, with a white ground and designs of red flowers. These mats enjoy a very high reputation on account of their solidity and workmanship. A factory has recently been established by a Chinese company at Phat-Diêm for the production of fine mats with varied designs and of brilliant colours, to be used as floor coverings and also for walls. This establishment, which was started in December, 1889, has at present in its employ fifteen Chinese and one hundred and four native workmen. The manager has recently applied for two hundred more Annamite workmen, which is a proof of the development and prosperity of the industry. Mats made according to patterns sent from Hong Kong are almost all forwarded to that place, where they are sold as local productions. Their usual price at Phat-Diêm is eight dollars per roll of 40 metres with a width of 90 centimetres.

General Notes.

SWINEY LECTURES ON GEOLOGY.—A course of twelve lectures on the making of the "Earth's Crust" will be delivered by Professor Alleyne Nicholson, in the Lecture Theatre of the South Kensington Museum, commencing Monday, the 1st of October. The lectures are given under a bequest from Dr. Swiney, who also founded the Swiney Prize, which is awarded by the Society of Arts every five years.

ROYAL CHORAL SOCIETY.—The Committee of Management have issued the prospectus of the Royal Choral Society at the Albert-hall for the season of 1894-95. The series will comprise ten concerts, of which the first will take place on November 1st. A special feature in the programme will be the first performance in London of Dr. Hubert Parry's "King Saul," on the 7th February, 1895, and Mr. Henschel's "Stabat Mater," on the 21st March, 1895. Both these works were composed for this year's Birmingham festival.

SOUTH SEA WHALING.—The Agent-General for Tasmania, Sir Robert Herbert, has received news from the colony of the recent revival of the whaling industry there. Tasmania used to be a principal centre of the Antarctic whale fisheries, the fleet numbering fifty sail, but during the past few years, as the South Seas were apparently becoming overworked, the industry has practically died out. Within the last month or so whales have been frequently seen on the Tasmanian coasts, two or three at a time having been noticed in Norfolk Bay.

Journal of the Society of Arts.

No. 2,184. VOL. XLII.

FRIDAY, SEPTEMBER 28, 1894.

*All communications for the Society should be addressed to
the Secretary, John-street, Adelphi, London, W.C.*

Proceedings of the Society.

CANTOR LECTURES.

TYPE-WRITING MACHINES.

BY HENRY CHARLES JENKINS,
A.M.Inst.C.E.

[THE RIGHT OF REPRODUCING THESE LECTURES IS RESERVED].

Lecture II.—Delivered May 7, 1894.

We traced last week the evolution of a machine adapted to the requirements of everyday life, from what was originally a benevolent effort to aid the blind. The writing in these machines could be performed faster than by a pen; it had a degree of legibility far in advance of ordinary writing, and some of the pieces of apparatus described were quite portable.

The typewriter, consequently, entered upon another stage of its career, and was merely waiting sufficient notice to pass into the hands of manufacturers, and become an article of commerce. This would, in the ordinary way of things, happen wherever labour-saving appliances were in the greatest demand, and where the means of reproduction of machinery had been most developed. The country where these conditions held to the greatest degree was the United States of America, which were just emerging from the disturbance in their trade, caused by the disastrous civil war. In themselves a nation of enterprising men, it only needed the appearance of a machine that would enable one man to do the work of two or three, and that in a much better manner, for that machine to be commercially successful, particularly as the appliance would repay the capital invested in its purchase in a couple of months. Much preparation work had been done by others; many had struggled to bring their inventions under public notice; but the credit of first taking hold of a market on a large scale must be given to Messrs. Remington, who, in 1874,

after only a year's work in their factory, produced the Glidden and Sholes machine. This they subsequently improved, and the improved machine is now well known under the name of the "Remington."

I am afraid that to-night I must quite depart from any attempt to present you, in historical sequence, with an account of what has since been done, since this would compel us to see the most incongruous things in juxtaposition; for no sooner had the typewriter acquired a commercial value, than a crowd of so-called inventors appeared on the scene, with the result that it is not always possible to readily distinguish the adventurer from the worker. Many of the essential parts have been patented over and over again, and we find the crudest productions reappearing time after time. Instead of the historical classification we must adopt some other mode, based on the characteristics of the machines themselves; and to do this to advantage we had better first see what work such a machine has to do, and what are the requirements to be met by it. Every machine, whether a typewriter, or a chemical balance, or a lathe, has to be designed and made to meet two primary conditions:—

First.—Its operation, or the work performed, should be done in the most perfect manner.

Second.—It should offer the greatest facility for its use to the operator.

A machine should also be as simple, durable, and cheap as is consistent with these conditions.

A typewriter, we have already seen, is, at the present day, essentially a printing machine, printing one letter at a time. It will be granted, moreover, that in by far the greater number of cases, the operator is, more or less, a copyist, and that authors, and other original writers, form a distinct, though important minority. Bearing this in mind, it will be seen that the conditions that a good typewriter should satisfy are—

1. The work should present an even and regular appearance, so as to exactly resemble a clear piece of printing in good bold type.

2. It should be performed in such a part of the machine as to be most readily inspected during progress.

3. The work should be performed by the smallest number of movements on the part of the operator, and these movements should be of the simplest and easiest character.

4. The mechanism must either respond correctly to the operator, or not at all; in other

words, every mechanical movement must be definite, and incapable of incomplete performance.

5. Durability is of paramount importance to the machine, and wear must not appreciably affect its performance.

6. The machine should be as simple as is consistent with its requirements.

7. The speed at which the machine will respond to the touch of the operator must be greater than that which he attains at any moment in the course of his work.

We shall find the most useful classification of the more complete forms of machines to be based on the mode in which the set of types is carried in it, whether on a wheel or on separate pivotted bars.

There are some uses to which a typewriter can advantageously be put that do not demand the above degree of perfection in the machine,

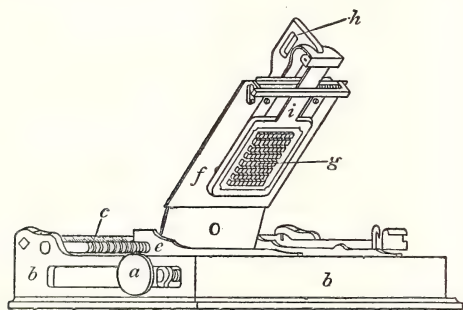


FIG. 1.—HALL'S TYPEWRITER.

as in the case of limited private correspondence. The amount of capital at command may limit a purchaser's expenditure, and in earlier days want of enterprise on the part of purchasers led many to try a cheap machine. The consequence has been that a large number of devices, many of great ingenuity and excellent manufacture, came into use, and yet were incomplete as labour-saving machines. I have excluded them all from this lecture, just as I have done to telegraphic apparatus and such machines as only produce an embossed paper matrix intended for stereotype purposes. But there are two machines of an intermediate class that deserve mention on account of the service done by them in familiarising the British public with a new thing. The first is the "Hall"* typewriter, Fig. 1; we learn, however, that the sale of this has ceased

to be of importance here, but for several years it was well known and received.

The machine is adapted to work either upon a flat or a rolled sheet of paper, the latter form being ultimately found more convenient. Fig. 1 is a view of one form of the original machine, where *bb* is a shallow, rectangular case containing the roller on which the paper is placed, the roller terminating in a milled head, *a*. A long rod, forming a cylindrical "rack," *c*, extends right across the machine, and in conjunction with a neat feed gear of which it forms part, performs much the same function as the screw seen in Hughes's machine. Swinging upon this rod is a flat case, *e, f*, made in two parts, the upper of which, *f*, forms a lid to the lower and carries an underplate. This is shown open, but is normally kept closed when it is flat down against the frame, *e*. The base of *e* is provided with a small square aperture, immediately over the paper roller, *a*, and of size just sufficient to allow one letter to pass through. A set of characters is provided on the surface of one sheet of india-rubber, *g*, which is held in a sliding frame, *i*, and connected to the handle, *h*, by moving which, any letter on the sheet, *g*, can be brought opposite the little square aperture already mentioned. A slight downward pressure upon the handle of *f* is sufficient to cause a small stud fixed to *f*, immediately above the aperture, to press the letter through it on the paper. Upon allowing the plate to rise a little, an escapement causes the whole tray to travel along the rod, *c*, and at the end of a line the tray is returned, and the paper itself shifted, as was the case in Hughes's apparatus. The mode by which the selection of the letters was brought about is very simple. The frame containing the india-rubber sheet, *g*, is mounted upon slide bars, and can be moved by means of the handle, *h*, in any direction in the one plane. An index-plate is fitted on the top of *f*, and this plate had as many notches as there were letters on the plate, *g*, and so placed that, when a little pin on the end of *h* would just drop down into the holes, the corresponding india-rubber letter is immediately over the square aperture in *e*. The inking was performed by placing an inking pad in the floor of the case, *e*, over which the types passed as they were adjusted.

This method of mounting the letters on a rubber band is very old; it was patented for use in machines for paging books as early as 1860, and has been re-invented since, for typewriters, many times,

* Specification, No. 827, 1881.

Hall's machine was well adapted to the limited employment for which it was probably intended, but the letters had to be smaller than the aligning aperture, and there was always a little uncertainty as to the exact position of the letter-plate in both directions on the paper, so that the writing had a distinctly irregular appearance, that became very objectionable as soon as any wear took place in the machine; in other words, its "alignment" was bad.

The other machine alluded to is the "Columbia." This is a dial machine, and does not possess a keyboard, and although it is still used, it belongs on that account to a period that is passing away.

A reference to Fig. 5, Lecture I., will readily enable us to follow the action of the machine, which was, however, very well and completely made of metal, and was of excellent design.

The paper is carried upon a horizontal roller mounted in a slide. Above, but with its axis parallel to the axis of the roller, a type-wheel is mounted, so that its axle can oscillate a little and the type brought to the paper at will. The type-wheel can be rotated by the fingers of one hand, and a horizontal dial is provided so that it can at once be seen what letter is in the printing position. Ink is automatically supplied from a small roller mounted against the type-wheel, and a depression of the hand prints the letter. As the type-wheel descends, a projection on the frame of the machine falls into a groove in the wheel and locks it in position, at the same time a detent is brought forward in order to be ready to advance the paper carriage for the next letter, when the type-wheel is restored to its initial position.

The machine was too slow to meet with all the success it deserved, owing to the necessity of making two movements for each letter printed, one of those movements, *i.e.* the adjustment of the finger, on the dial to the letter, demanding skill to perform it at all quickly. The machine would be well adapted to write in simple cypher if that were ever needed. One great feature of interest in the Columbia, however, is in the fact that the spacing detent is moved a different amount for different letters, and so the machine produced writing that was a nearer approach to printing than was usual. The patentee, Mr. Spiro, of New York, a well-known worker in the type-writing field, and since identified with an important keyboard machine, says, "The feed motions of the

pawl v will vary from one to four teeth in accordance with the varying depth of the recesses in the type-wheel representing the letters, thus producing a perfect and efficient feed motion which regulates the feed of the paper automatically according to the width of the characters printed, which is a very desirable feature, as it saves space in the sheet, and greatly improves the appearance of the printing and renders it more readable." This judgment of the question of properly spaced writing will meet with the more ready approval when it is seen subsequently how easy it is possible in keyboard machines to get good-looking work without complication or risk of failure.

We must now pass to the consideration of larger and more complete machines.* You will notice the common feature to them all: they have a keyboard, and they contain a complete set of characters, so arranged that the depression of a key prints a character on to a sheet of paper, held in a more or less convenient manner. They contain also a stock of ink, that can be supplemented from time to time. Some years ago, a list of qualities that these complete forms should preferably possess was presented to me, as being the result of careful inquiry amongst operators. The list of qualities is as follows:—

1. The alignment should be perfect.
2. The machine should "manifold."
3. The writing should be correctly spaced, similar to that of printing.
4. The writing should be instantly visible.
5. The line feed should be variable, and effected by one movement at all times. The same movement that effected the line feed should be utilised, so as to draw back the paper carriage for a new line.
7. The paper should be inserted in its carrier without previous preparation.
8. The paper carrier should take large sizes of paper.
9. The machine must have a keyboard, preferably with a single change of "case."
10. The machine should be rapid in its action.
11. It should be as noiseless, simple, and durable as possible, and weigh about 20 to 24 lbs.

It has been found to be quite possible to meet the whole of these requirements in a single design, although any design must

* Specification, No. 14768 of 1884, p. 6.

* A number of machines were kindly lent by the manufacturers or their representatives,

necessarily contain features in which a compromise between conflicting conditions is made. Take, for instance, the 1st requirement, and the 9th, 10th, and 11th. The first requirement will be found to be solved by either using a locked type-wheel, which infringes the conditions of visibility of writing and noiselessness, in a marked degree, or else by using type-bars with a single type in each bar. I prefer the latter method, though this has needed a special invention to accomplish simply and yet retain the small keyboard; indeed, many came to regard a big, unweildy keyboard as a necessity, in order to secure the advantage of a single type on a single bar. Even the preference for a small keyboard is due largely to the small use we make of capital letters mixed with small ones. Most of our writing is done with small letters and figures, or else with all capitals and figures. One change of case is thus a distinct advantage, as the operator is able to manipulate the machine without moving his hands so much about, and without being embarrassed by a large selection, for even the expedient of making the keys a different colour from one another is not sufficient to help the choice under the stress of rapid work. Unfortunately, a habit has arisen amongst many operators of "fingering" the typewriter in a most demonstrative and laborious way, and in which the arms take far too great a part, but as the performance is as ludicrous as it is irrational, the fashion is sure to pass away. It has no doubt arisen from the desire of makers to get what they call a "light touch," and in order to do this they have given us machines having, amongst other sacrifices of the conditions for speed, far too great a depression to the keys. A movement of four-tenths of an inch should be quite enough, and machines can be built with much less, and yet be worked without fatigue. The "touch" has a good deal to do with the limitation of speed, and if we could use our fingers faster than we do, machines would *need* to have a heavier touch in order to respond to them.

So much for the keyboard, for although attempts have been made to use two or even more changes of case, yet they cannot be considered to be successful, as the fingering tends then to demand too much thought. Besides difficulties of a serious kind appear and have to be dealt with in the machine itself.

We will pass on to consider the characteristics of the two great classes of the keyboard typewriters, namely:—

A. Those in which the printing characters are mounted upon a wheel.

B. Those in which the printing characters are mounted upon a set of pivotted bars, so arranged as to bring all the characters to one or more printing points.

Pratt's machine (Figs. 12 and 13, last lecture) was a very good specimen of the class A, but it was never made in numbers. Fig. 2 shows some views of Crandall's machine,* which, with some important modifications, was at one time sold in some number.

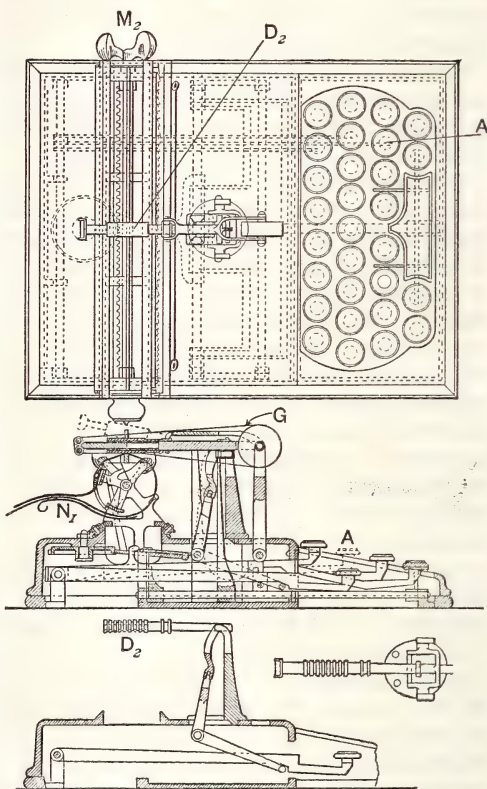


FIG. 2.—CRANDALL'S SPECIFICATION, 1879.

Fig. 3 (p. 359) is an enlarged view of some of the details. The type-wheel, D₂, is mounted upon an approximately horizontal rocking arm, by which it could be depressed by the action of any of the keys, A, on to the paper after the character had been selected by that key, in a very similar manner to that adopted by Pratt, namely, by a rotation of the wheel, D₂, coupled by translation in the direction of its axis. But with this difference, that the pressure of the finger on the key, A, did all the work, and springs were only employed to restore the

* Specification, No. 3253, 1879.

apparatus to its initial position. Crandall, however, used a longer type-wheel than did Pratt, and with only nine letters around its periphery, whilst there were nine rows of them, so that the two motions of the wheel were of equal importance. In the machines as placed upon the market, the axis of the type-wheel was vertical and arranged in front of the paper, which was mounted upon the usual cylindrical support. There was no separate hammer to the machine, the type-wheel being itself depressed to meet the paper. Ink was supplied by the agency of a ribbon interposed between the face of the type and the paper.

The paper was originally carried not on a cylinder, as was subsequently the case, but in a light frame (see N_1 , Fig. 2), in which it was held by spring clips, over a strip or long platen fixed in the carrier. When it was desired to feed the paper forward at the end of a line, it was dragged the necessary distance by means of two "gripping" jaws: one on each side of the sheet, and both worked by one handle (M_1 , Fig. 2). Crandall saw the advantage that a type-wheel machine possesses, in the readiness with which one type-wheel may be exchanged for another, and provided ready means by which the change can be effected. It has since been found that this advantage

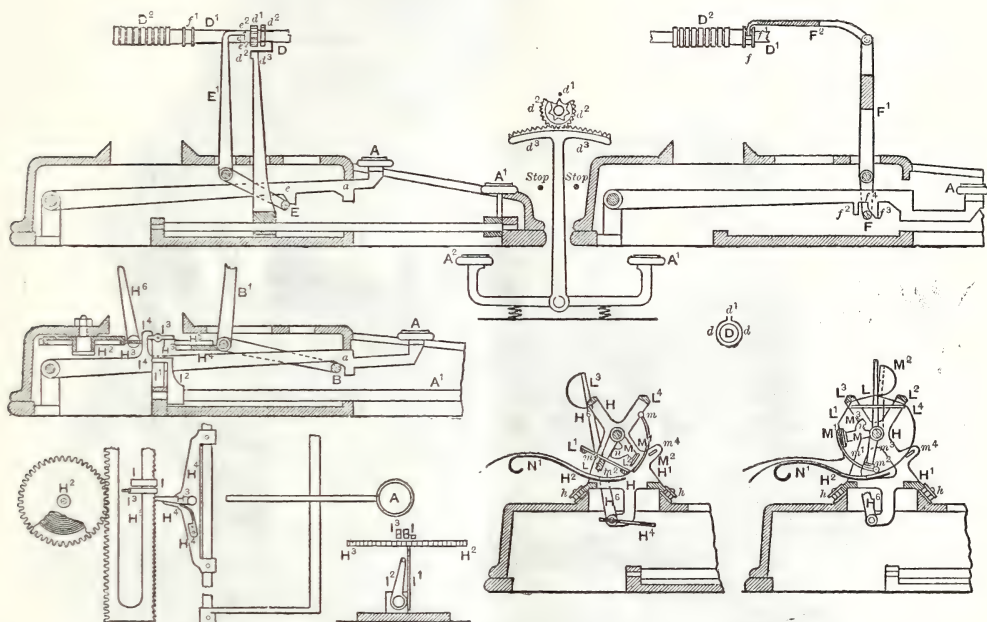


FIG. 3.—DETAILS OF CRANDALL'S SPECIFICATION, 1879.

is more apparent than real in the great majority of cases, for just as one style of handwriting is sufficient for most of us, so one complete fount of characters is sufficient for operators, and, so far, type-wheels carry many disadvantages with them. Crandall also made his machine to print the **M**'s and **W**'s of greater width than the other letters, and adopted a very simple contrivance to effect this: he moved an auxiliary impediment out of the way of the escapement of his paper carriage, and so enabled the latter to move a greater distance whenever these letters or capitals were to be printed. This principle has since been shown to be capable of being

made of great use, as will be seen later. Crandall's machine did not make much headway; it gained a rather unenviable character as being noisy in its work. This is easily explained, when one considers that the machine violates the first principle in design that must be observed if noisy working is to be avoided, namely, that the pressure of one part upon another throughout the whole train of mechanism must never be reversed in direction.

The well-known "Hammond"* machine belongs to the same class, although here the

* Specification, No. 5789, 1883.

type-wheel is reduced to two small segments of a vertical cylinder, and the types are arranged in three rows only. These segments are put in front of the paper and the selected type is struck by a little hammer from behind. The three rows of type correspond to a double change of case, and the machine shows much evidence of skill in its design. It may be considered to be, so far, the best example of its class.

Munsen's machine has recently been before the public. It has a long type-wheel like Crandall's, but with horizontal axis, parallel to the paper, and like Hammond's machine employs a hammer by which to strike the paper on to the type from behind.

Although type-wheel machines admit of easy change in the fount type, it will be seen that there is always a distinct tendency to noise, owing to the movements of the compara-

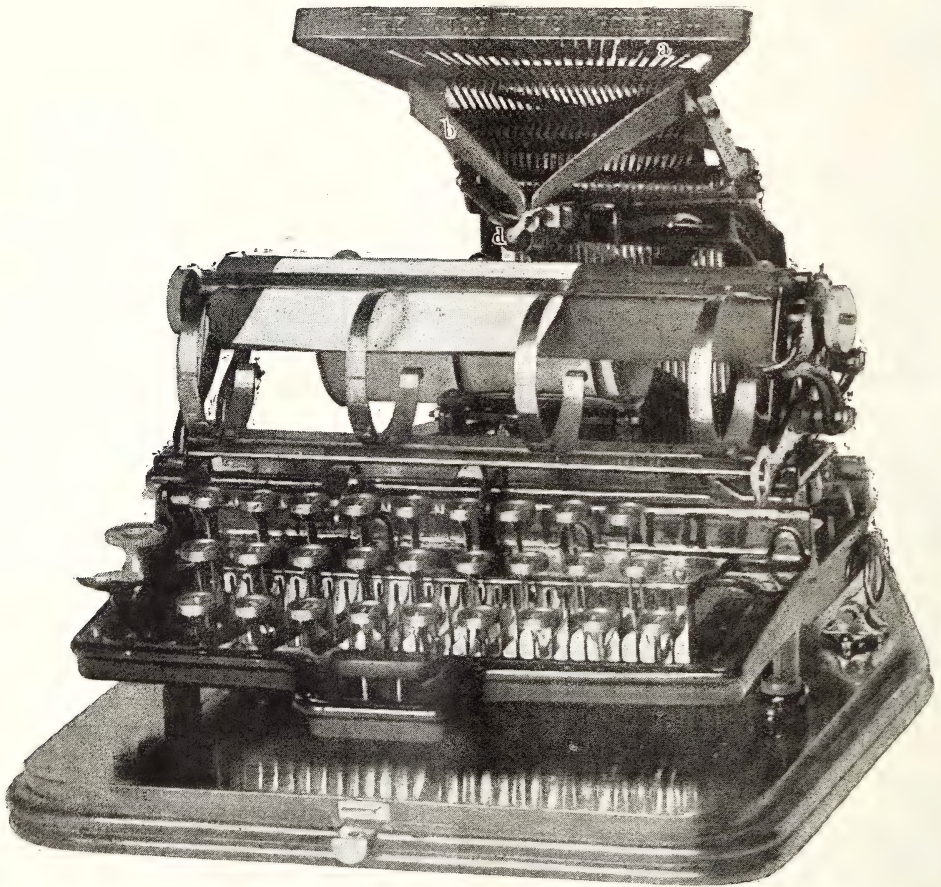


FIG. 4.—FITCH'S MACHINE 1886-87.

tively heavy wheel, and the conditions are not favourable to ready visibility of the writing.

We now pass to the consideration of the pivotted "bar" machines, to which class by far the greater number of the complete type-writing machines belong.

The representatives of the class are those machines possessing a little lever for every character, as was the case in Dr. Francis' and Beach's machines. When this is the case,

the risk of these little levers hitting one another on their way to and from the printing point is at a minimum. Such machines also possess only one printing point, and the alignment of the printed work is always good, as the axis of the paperholder is fixed with reference to the centres about which the little type levers turn. These machines generally have large keyboards, and the Bar-lock and the Caligraph are good examples. There is one machine,

the Waverley*, that possesses this feature coupled with the advantage conferred by a smaller keyboard with a change of case, and in this respect it is unique.

Then there are the machines possessing the smaller keyboard, but with only half the proper number of bars, each bar, however, having a couple of characters mounted upon it that agree with two printing points, to either one of which the paper can be adjusted by the "change case" key. The Remington is the best representative of this group, and in it the paper roller is moved upon its carriage† from one printing point to the other. In other machines, such as one privately shown, as the "National," the whole set of type levers is moved, whilst the paper remains stationary. Other machines have no less than three printing points, as, for example, the "English," and Mr. Maskelyne's machine, where the paper roller was moved to one or other of these printing points, and the "Fitch," Fig. 4, page 860, where the type-bars partook of the motion. The smaller number of type-bars required in these machines, as compared with machines like the Bar-lock, would, at first sight, appear to offer many advantages, on the ground of simplicity. But, it must be remembered, that these smaller number of parts get an increased amount of wear, as they are necessarily used more often, and that there is the far greater trouble of the parts catching in one another when worked rapidly. Moreover, the two or three printing points can only be even, approximately, in the plane of lever upon a very few of the levers. In the others, only one character will deliver its blow fairly; the extra characters must, when struck on the paper, set up very undesirable stresses, and cause rattling on the pivots, trivial at first, but leading to blurring and noise in the end. In Fig. 5 which is a plan of these type

points, *a*, *b*, *c*, in the plane in which it moves; but for the "bars" B and C (shown to the left and right respectively) two of those points necessarily lie out of the planes of the "bars;" and the line, *d*, *e*, shows how obliquely the blow has to be delivered for the line of writing, *c*.

This is not of so much moment, where only a simple change of case is needed, particularly where the points can lie one on each side of the bar, but in many machines the exigencies of working compel the most unfavourable point, *a*, to be in the plane of the bar, and the other two to be both on one side. The evil is much exaggerated where pivots are not used, and where the bars slide in grooves. The shifting of the printing point, moreover, with relation to the line of work in progress, is certainly a defect, and tends to give badly aligned work as soon as rapid writing is attempted.

There is another way of effecting change of case and diminishing the number of bars, but it is really too expensive, and would involve too many joints in which wear would lead to serious consequences, to be practical. It is Donelley's ingenious invention,* which forms a connecting link between the "type-wheel" and "bar" machines. Each pivotted bar (H, Fig. 6) is a shaft, and carries what is really a little type-wheel at its further end. The stems of the bars are provided each with a little spur wheel, D, that gears with a large ring-shaped wheel, E, that lies in the outside case, M, concentrically with the printing point. It is quite possible to keep the wheels, D E, always in gear, for although the teeth of the wheel, E, would then be radial, yet the difference in their pitch is not sufficient to prevent their gearing with the spur wheels at different parts of their paths. But in the patent drawings from which this has been prepared, the wheel does not remain in contact quite so long. The printing is performed by pressing down the finger-plate, I, which causes the end of the bar, H, to approach the paper and to print the character that was facing downward at the time. But by causing the ring, E, to rotate, all the little wheels were rotated, and all the bars, H, to which they were connected, so that a fresh "case" of type would be presented for printing. Donelley only employed two changes, or three sets; he might have had half-a-dozen.

We will now consider some of the methods

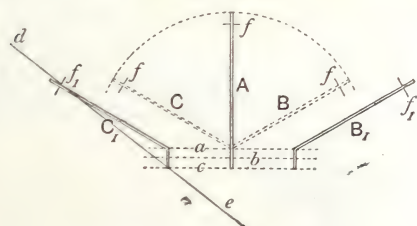


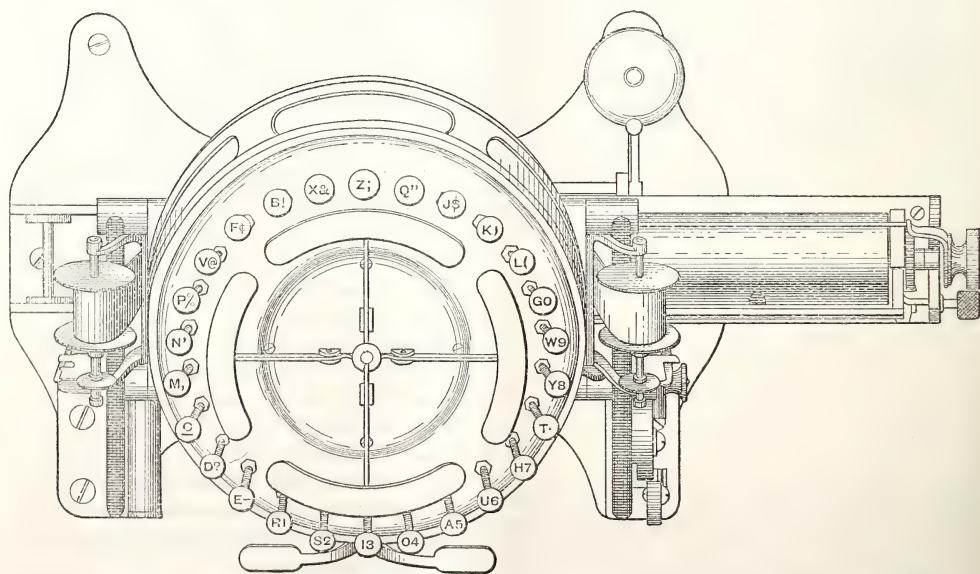
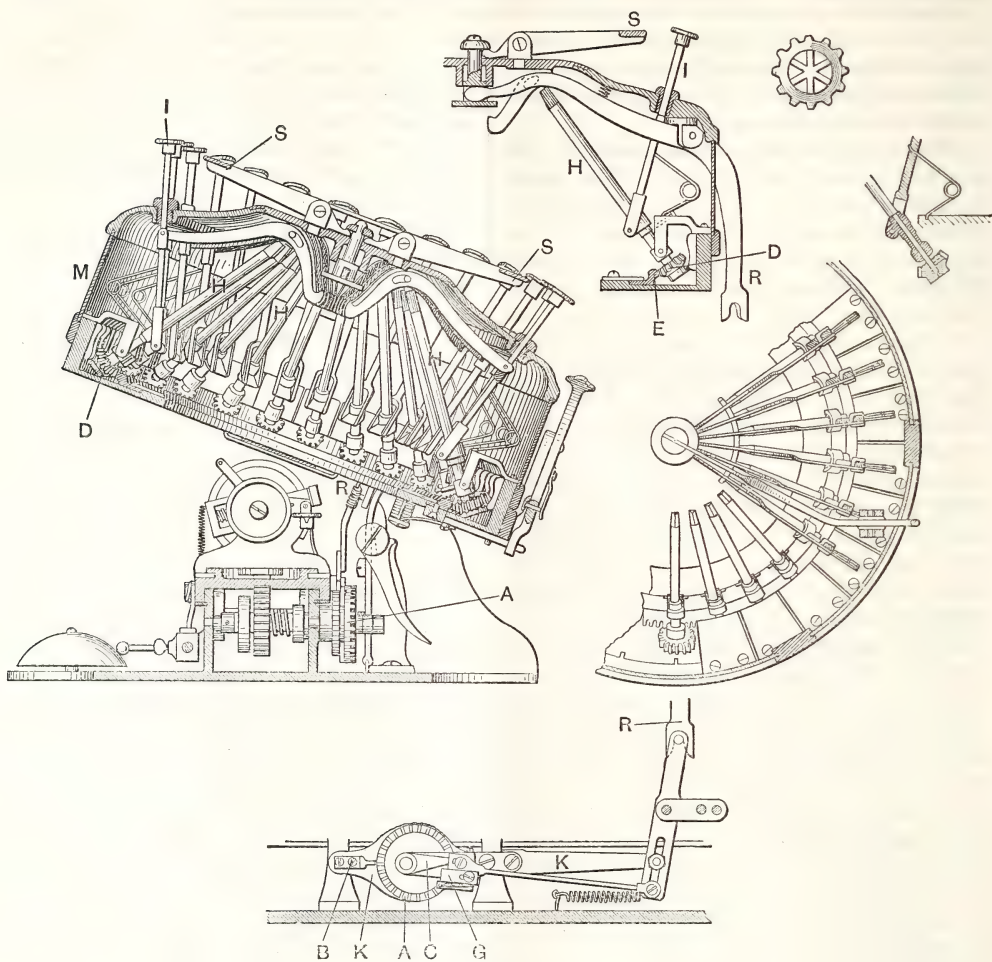
FIG. 5.

levers pivotted at *f*, *f*, *f*, it will be seen that the central bar, A, can have all three printing

* Higgins' and Jenkins' series of patents.

† A working model was shown projected on the screen.

* Specification, No. 9177, of 1887.



which correct alignment of the type-bars may be secured. They will differ according to the class of machine. In type-wheel machines, no doubt the most effective means is that so crudely shown in Fig. 5, p. 845, where a fixed pin passes into one of a series of holes, which it fits, in the type-wheel and prevents it from doing anything but approach the paper. Each hole, of course, corresponds to a separate character. These means are adopted in the "Columbia;" the equivalent is done in the "Hammond" and in all machines where the pressure of a spring is made to rotate the wheel or segment against a fixed stop placed in its path by the action of the finger key.

For "bar" machines there is a great choice of means. A few makers get the pivots of the bars as long as possible and trust to these fitting accurately. This, for instance, is done in the Remington machine, and carried to its greatest perfection in the Smith-Premier machine, where the shaft of the lever is arranged on one side only of the latter, and the shafts arranged tangentially to the circle around which the levers are themselves arranged. By fitting each shaft with a tubular holder it is possible to make them of any length desired. But it is easy to make very steady and satisfactory pivots without going to extremes, indeed the vibration of the stiff little levers themselves is as important as the vibration in the pivot, and these extreme measures are, after all, only necessary where several characters are on one lever.

Another, and by far the favourite method, is that adopted by Densmore in 1871,* and Daw, in 1884.† Here a freely working pivot is used, and the bar, just at the end of its journey towards the paper, is made to drop into a groove that it nearly fits, placed some distance from the pivot.

The groove, however, is only a safeguard against accidental treatment, rough enough to forcibly displace the pivot and its support, for if made too loose the pivot is not assisted, and if it fits too closely upon the lever it causes friction, and worse still, sets up vibration in the bar just as the character touches the paper, and so causes a blurred impression.

Another method is that of providing a little hole at the printing point, through which the character may be put. The hole is made to nearly fit the shank upon which character is formed and thus hold it in position. It is difficult to say who used this method first, Dr.

Francis seems to have done so, and Hall certainly did. Yost in his machine employs a jointed bar, that is so flexible as to absolutely need this device and obtains very good results by its means. It demands, however, that every type-head should be the size of the largest character in the set, and this causes the speed to be seriously affected on account of the interference of these big heads, the one with the other, when in the neighbourhood of the printing point.

Fitch* made an exception to the rule, and boldly used an aligning guide in order to bring his character to the printing point. His type-bars or levers, *a*, Fig. 4, were not arranged as is usual in a circle, but in one straight row, and the levers were jointed so as to swing sideways to the printing point as they descended. This they were made to do by means of the guides, *b*, *b*, seen in front of the machine, and at the end of their journey had to pass down a narrow slit that they just fitted. This effected the purpose, but it introduced other, and undesirable, features.

The mode in which ink is conveyed to the type will be found to differ greatly in machines. We saw that in the early machines "manifold" paper, *i.e.*, a sheet of thin paper, covered on one side with a very dry form of ink, was used between the types and the sheet of writing, so as to leave a black impression from the character where the latter struck it on to the sheet or strip of paper. Silk was, we saw, soon substituted for the paper, and a more fluid ink, containing glycerine to keep it moist until it reached the paper, was employed, and with these improvements the ribbon has been generally adopted in bar machines.

The ribbon is invariably shifted a short distance at each stroke of the machine, and this is effected by having it wound by the action of the keys from one spool to a second spool, and making it traverse the printing point in its journey. Fitch's machine was supplied with an inking-roller, *c*, Fig. 4, that passed over the face of each type as it descended, and then swung out of the way. It was a good feature of the invention, and enabled him to justly claim that the machine performed writing that was immediately visible. Many machines belonging to the "type-wheel" class are provided with little rollers, as, for example, the "Columbia;" whilst some makers, like those of the Ham-

* Specification, No. 3177, 1871.

† Specification, No. 246, 1884.

* Specification, No. 9421, 1886.

mond's and Munsen's machines, prefer the ribbon. I believe myself that the choice is justified by the increase in convenience. But a fixed inking-pad, on which the types may be made to touch before they are brought to the paper, has for many years possessed a fascination to inventors, and several machines that have been brought forward of late years possess this contrivance. With one exception, it appears to have been adopted with a view to secure immediate visibility of writing, as in Williams's machine and in that of Maskelyne,* but the adoption is deliberate in the "Yost,"† and secures no collateral advantage, for Yost's mechanism leaves the paper in the same unsatisfactory position for inspection that it occupies in the "Remington."

In all cases the adoption of an inking-pad necessitates the adoption of a jointed or complex type-bar, and this in itself is a most undesirable feature. The pad, moreover, is always exposed to dust over its whole surface, whereas only a small part of the ribbon is so exposed at any one time. And it is easy to so arrange the ribbon† that it can be, without disturbance to the action of the machine, automatically lifted from the paper as the type leaves it, and so reveal the writing as it progresses. This is the more important, as it is the last few words and letters it is so necessary for the operator to see, particularly if he is, as is so often the case, copying from a shorthand draft; and this leads us to the means provided for the examination of the work in progress. The Remington, Caligraph, Smith-Premier, Densmore, and Yost machines all have means by which the paper carrier or holder can be turned over upon some kind of a hinge, and the writing, which has been performed under and out of sight, is brought into view. Operators get so used to this, that they scarcely know how often they do it, but it must consume much time. It has been proposed to use prisms beneath such machines, and to see the last line of writing by reflection, but this is scarcely a satisfactory method. Donelley inverted matters—the step is not a great one—and placed his typewriter above the paper, so that when it was required to inspect the work you either looked through the mechanism, or else you turned the typewriter itself over out of the way, a hinge being provided for the purpose. It is by far better to have the writing where it can always be

seen, and in a few machines this is so. In the "Bar-lock" and in the "Maskelyne" machines the paper is in view at the back of the machine, and behind the type-bars; in the "Williams" it is in the middle; whilst in the "Fitch" and in the "Waverley" it is in the immediate front.

It has been found that our correspondence and our work can be done upon a few sizes of paper. Most machines have holders adapted to either foolscap or "brief paper," although quarto is the size most adopted. A few machines will take any size of paper, but this appears quite unnecessary. Where they do not have type-wheels and a hammer, they generally have a cylindrical or polygonal support, on which the types can strike. Attempts—though with only partial success—have been made to employ a narrow platen, as in Crandall's machine, but as this has to receive all the wear, it has not replaced the cylinder. The step by step rotation of the latter, moreover, offers a ready and simple means of advancing the paper at the end of each line. The holder, however, should admit of the insertion of the papers—often a number at the time—as when manifolded work is wanted, with the greatest readiness, and whilst holding the paper firmly in position, should allow it to be shifted by a knob or handle, without the necessity of employing the second hand, which should be left free for other use. In one machine, at least, all this can be done, and that without removing any catches beforehand. One important feature now remains to be noticed, viz., the means by which the paper is moved at each stroke of the keys, so as to provide the necessary spaces for the letters.

Very early in the history of the typewriter (by Dr. Francis, for instance), a spring was employed to keep a constant pull upon the paper-holder in the direction of writing, in conjunction with some form of escapement, that only permitted a limited amount of movement each time a letter was printed. Pratt adopted this in 1866, although, in 1868, Glidden and Sholes only went half way and adopted the equivalent of the spring, in the form of a weight, that merely assisted a feed motion of the keys. But the use of a spring and an escapement soon became universal. In most of the early commercial machines only one length of letter in the line was adopted, and the machines provided with capital letters only and figures—it was not difficult to make these all of one width. But in America beauty soon gave way to con-

* A working model of the mechanism of each of these machines was projected on to the screen.

† Specification, No. 17351, 1889, &c.

venience, and founts of small letters were made and used, in which the grave difference in width that exists between an **I** and an **M** was more or less ignored.

Hall, in 1861, had shown that better things were possible, and attempts were made to mend matters, as in the Crandall and in the Columbia machine, but the debased founts have been retained in most typewriters—indeed, they had to be so retained on account of the machines, and many persons have gone so far as to tell us the ugliness is better. The ordinary escapement that has thus come into such use is shown in Fig. 8. There are as many variations existing as the mechanism allows, such as the use of two racks, or the detents placed on paper-holder, or else on the frame of the machine, &c., but nearly all those now in use reduce ultimately to this

figure, which closely resembles the one to be found in the well-known Remington machine.

The rack, A, is always pulled in the direction of the large arrow, but is prevented from moving relatively to the piece, D, by means of one or other of two teeth, B and C, that can engage in it. A is usually placed on the paper holder, and D is put on the frame, but the positions may be reversed with suitable modification. The “dogs,” B and C, have a weak spring between them that is always tending to separate them, and the end view, Fig. 8, *b*, shows that C and B do not lie in one plane, but in parallel planes. The movement of any one of the keys of the keyboard causes a pivoted frame that passes under all the keys, and is connected with the arm, E, to be depressed, until E rotates sufficiently to allow the tooth, B, to completely enter the tooth of

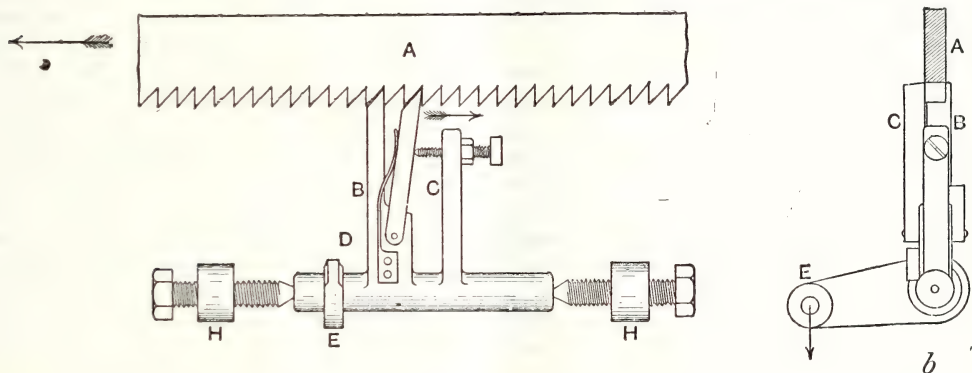


FIG. 8.

the rack, A, whilst the tooth, C, will be at the same moment at liberty to take up the extreme position shown in the figure. This, it will be seen, occurs during the time that the letter is being printed, and the rack, A, to which the paper is in rigid connection, has not been allowed, so far to move. When the operator allows the key to return to its initial position, the arm, E, rises again, and moves the dogs, C, and B, to the right, causing B to drop out of the rack, whilst C passes into a tooth of it. The pull on A, to the left, is much stronger than the push of the little spring, B and C, in the opposite direction, and thus as soon as B passes out of A, C is overcome, and allows A to advance the space of one tooth. It can now go no further, and remains in this position until another key is depressed. At the end of a line the rack, A, is lifted out of the way of the dogs altogether, and forcibly pulled back by the operator, who by this means winds up

the spring for the next journey of the paper holder.

We are now in a position to study the Crandall escapement, whereby an increased space was given to the **M**'s and **W**'s. It will be seen that H_4 (Fig. 3) corresponds to the piece, D, and vibrates under the action of the letter key, A. The teeth, H_4 and H_8 , which correspond to B and C of Fig. 8, both work, in this instance, in the same tooth of the rack, here marked H_6 . The impediment against which H_8 rests when a letter is struck, is distinct from H_4 , but is fixed to the frame and is lettered **I**, and the rack can pass through or under it. The feature in Crandall's specification is that he placed in front of **I**, a temporary impediment, I_8 , which, in ordinary cases, only allows H_8 to move a space equal to the width of the letter **N**, but which can be moved out of the way whenever **M** has to be printed. When this is done, the oscillating piece, H, moves, until

it touches I itself, and this amount of movement is double the first mentioned amount. For capitals he provided a further movement of an extra tooth of the rack, and here departed from the principle he had touched, for he provided this extra movement by shifting I and I_s *sideways* the space of the tooth, and thus rendered the mechanism indefinite in its action.

We have already mentioned the spacing mechanism of the "Columbia;" this was much more complete, and very ingenious, but was special to the machine.* There was no spring drum to the paper carrier, but there was a rack attached to it, and each complete movement of the type-wheel caused a detent to slide forward over the rack as the character was imprinted, and then, upon the return to initial position of the type-wheel, the detent pushed the paper carriage onwards the amount it had previously travelled. This was not the same for all letters, for, in the case of the narrow ones, an impediment on the type-wheel causes the tooth of the detent to cease its forward motion, after it has slipped over one, two, or three teeth, as the case may be, and come out of the rack. Consequently, on the return journey, the detent has first to return to the rack, and then can only push the carriage onward until it reaches its normal position again.

We saw that Vicker's machine (Fig. 1, p. 841) was provided with the rocking frame passing under all the keys, and that a variable movement of this rocking frame caused the feed of the paper to be different for different letters. This recurs in the next example, only in a much disguised form. It is in Donelley's machine, where he attempted to obtain terminal spacing simultaneously with the printing of the last letter of each word. This has been a problem that far-sighted men saw would be an important one to satisfactorily solve, as the formation of the spaces at the end of words occupy at least one-fifth to one-sixth the total time of printing. Donelley's escapement does not in itself present any great feature of interest. There is a circular wheel, A, in the place of the straight rack, and the dogs, B and C, are mounted on a flat plate that is made to slide to and fro immediately behind A. This is effected by the agency of a rocking arm, R, that oscillates whenever a key is depressed, and a letter struck. The impediment, G, corresponds to the impedi-

ment, I_s (Fig. 3) of Crandall's machine, but is removed only when an extra amount of travel is given to the piece, R. This is given by simultaneously pressing a letter key and the spacing key, S. Donelley made further attempts to improve his detail, but without any alteration in principle which was distinctly faulty, as an incomplete movement for one operation corresponded to a complete movements for another, and thus the action would lack the quality of being definite.

There is another escapement—the one in the "Waverley"—to which I must refer for the sake of completeness, although my own intimate connection with the novel features of this machine would lead me to here say but little about it. But a simple solution is there to be found by which we can not only correctly space the letters, but also obtain the spaces at the end of words simultaneously with the last letters of the words. The letters of our alphabet agree very closely with spacing in the ratio of 1, 2, 3, most of the letters being of the medium (2) width. This ratio was, after careful consideration, adopted, and Fig. 9 (p. 867) shows (diagrammatically) the escapement. It has a rack, A, attached to the paper carriage and the sliding dog, C (corresponding to the dog, C, Fig. 8) that can fly back, under the action of the spring coiled around D, whenever a letter is struck and the arm, E, raised, this arm being connected with the keys by means of the usual pivotted frame. The fixed impediment is G, and the face of this is hollowed out so that the piece, C, can slide along D until the edge, C₂ abuts against G:—a distance of no less than a quarter of an inch, equal to the space occupied by an **M** and an **N** in the line of writing. There is a second edge, c, to the piece, C, that is exactly the space of an **N** from C₂. FF are two bars or adjustable impediments that are pivotted at both ends. Their thickness is their important dimension, and this is, in each case, one half that of an **N**. There is, consequently, the same space as one of these bars occupy, left between the end of C and FF, and whenever a narrow letter is printed, such as **I**, the escapement vibrates similarly to that shown in Fig. 8, and the piece, C, only being able to travel this small space, will only allow the paper to subsequently advance the same amount. If wider letters have to be printed, it is arranged that the keys also lift either one or both the pieces, F, to the position shown by dotted lines in Fig. 9 *b*, thus providing for the subsequent

* The spacing mechanism is illustrated in Drouin's work, p. 35.

increased movement of the paper-holder. When the spaces at the termination of a word are to be made, a key is depressed in the keyboard by the thumb or the second hand of the operator, and this lifts up the second (left-hand in the figure) end, or fulcrum, of the impediments, FF , to the position shown by full lines, Fig. 9c, C_1 . This edge is now quite inoperative, and every movement for which the keys have been arranged is increased by the distance between the two edges, C_2 and C_1 . This is equal to the space between two words, so terminal spacing is correctly performed whatever be the last letter, and, in addition, diphthongs are easily and correctly written. The action of this escapement it will be seen is quite as certain as that in Fig. 8, for imperfect or excessive movement of the keys is without effect upon its action. Notwithstanding the fact that it spaces in no less than five dif-

ferent ways, it could do so in more by simply increasing the number of strips, F , F .

Mr. Maskelyne, of London, also made a recent attempt to adjust the spaces of the letters, but adopted the ratio, 2, 3, 4, which in the author's opinion does not give nearly such good working. His escapement does not give any facilities for simultaneous terminal spaces; these have to be separately made in the ordinary way.

There is one remark to be made as to the use of oil in type-writing machines. In a well-made typewriter oil is scarcely ever required, if at all. The parts are so well fitted as to render its use quite unnecessary, and its presence is only likely to give trouble by the oil becoming sticky and collecting dust. Anything but the finest clock oil must be absolutely avoided if an operator desires to keep his machine in order, and it should only be used in the most sparing manner.

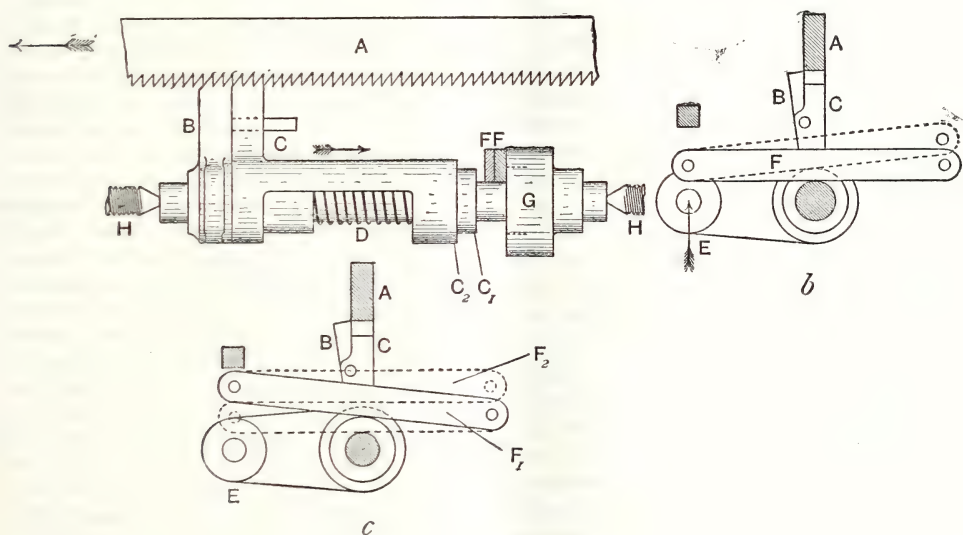


FIG. 9.

STENOGRAPHIC MACHINES.

Some few machines have been invented* to operate upon a running strip of paper, and provided with only a very small number of keys, generally ten. These machines were arranged so that any combination of the characters could be written simultaneously. It was imagined that a code could be formed of the characters that would permit of such rapid manipulation as to render the use of shorthand

needless in reporting. Such machines have never gone much beyond the experimental stages of their existence, as the noise made in their use would be very objectionable in a public meeting, though if such appliances were needed, there is no reason why ordinary typewriters should not be so modified as to adapt them to the use of an abbreviated system of signs for reporting purposes. Shorthand has, however, been found more suitable so far for the purposes of the reporter, and so it continues to be in use, as it is likely to remain for many years,

* As, for instance, Spec. Nos. 9048 and 13532, of 1884.

I have endeavoured in these two lectures to give the salient points in the history of one of the more recent gifts of the mechanical engineer to the world, and have therefore preferred to draw the illustrations from many machines, and that, if possible, from the earliest proved examples, rather than describe the later machines in detail. There are, however, many interesting pieces of mechanisms and ingenious contrivances* in use, that I have not had time to even mention, but which would repay attention. It is somewhat marvellous that the country in which the late Sir Joseph Whitworth did so much to advance the adoption of accurate methods of work, and in which so many improvements in the manufacture of steel have been made, should have treated the typewriter with apathy until recently. The use of the modern material, mild steel, has given a great impetus to the adoption of the die-press in workshops. It is possible now to produce complicated forms in metal that are almost finished, and can easily be brought accurately in large numbers, to predetermined sizes at a cost which is so low as to enable elaborate pieces of machinery to be completed at prices that bring them within the range of every-day use. The opportunity was first seen and seized in America, but manufacturers here are now awakening, and there is no reason why this country, as in the past, should not supply itself with all its machinery but should even export it. The typewriter has already done the indirect service of withdrawing some of the delusive inducements that the demand for copyists offered to the industrial youth of this country, which has led so much to the neglect of the handicrafts. It has also had a direct bearing on the industrial progress of our country by lessening the cost of correspondence, a benefit in which each individual member of what is essentially a commercial nation must ultimately participate.

Miscellaneous.

CUSTOMS' REPORT.

The thirty-eighth report of the Commissioners of Her Majesty's Customs for the year ended 31st March, has just been issued. The report states that the gross receipt of Imperial Customs revenue, including warehousing charges and the revenue of the Isle of Man

for that period, amounted to £19,964,319, an increase of £78,980 over the corresponding amount collected in the previous financial year. This increase is less by £90,045 than the amount which would have been collected had the increase of revenue corresponded to the estimated increase in population of 0·85 per cent. A further amount of £199,795 was collected from Customs duties, on behalf of the local taxation, created by the Act 53 Vic., c. 8. The total gross receipt on account of Customs revenue was therefore £20,164,114, and of this amount the sum of £2,247,286 was collected by the officers of Inland revenue, so that Customs officers collected £17,916,828 only on account of Customs revenue. They also, however, collected £5,327,975, on behalf of the Excise revenue, and the total amount of gross revenue collected by them was therefore £23,244,803. It appears from the tabular statements that are attached to the report, that the gross produce of Customs duties on chicory showed a falling off in the year ending 31st March, 1894, of £3,722, as compared with the previous financial year. Cocoa showed a diminution of £4,191, coffee £8,035, raisins £2,278, rum £147,111, tobacco and snuff £4,637, and wine £58,883. Increases were shown in the following articles:—Currants, which realised an excess of £20,598; figs, plums, and prunes, £1,058; brandy, £31,264; geneva and other kinds of spirits, except rum, £156,709; and tea, £93,684. As regards the latter article, the last annual report of the Commissioners showed for the first time for many years a decrease in the consumption of tea. In 1893-94, however, there was a substantial advance, the figures for the gross yield of Customs revenue for the three years being—1891-92, £3,424,830; 1892-93, £3,406,225; and 1893-94, £3,499,909, an increase in 1893-94 over 1892-93 of £93,684, or 2·75 per cent. Although the receipts from wines continue to show a downward tendency, as regards sparkling wines there has been an actual increase of yield of £11,928. An interesting Table appended to the report relates to the number of detentions and seizures of goods under the Merchandise Marks Acts during the financial years from 1888-89 to 1893-94 inclusive. This Table shows that the number of detentions has increased from 3,880 in 1892-93, to 4,899 in 1893-94, exclusive of the parcel post. The number of detentions in the parcel post has fallen off considerably, having decreased from 1,141 in 1892-93 to 617 in 1893-94, of which 97 were ultimately seized. The principal countries from which the goods detained were imported, were as follows: Germany, Holland, France, Belgium, United States, and the British Possessions.

ORANGE CULTURE IN TAHITI.

The orange-tree was originally introduced into the Society Islands, from Brazil, by the Navigator Cook, and subsequently by the early missionaries, from the Australian colonies. These two varieties, though still showing a slight difference in species, have by

* Such as Mr. Secundo's word counter,

acclimatisation and self-propagation, become merged into one variety, known in the markets as the Tahiti orange. Her Majesty's Consul at Tahiti, says that the fruit varies from oval to oblong in shape, being well flattened at the blossom end. It is moderately large, very heavy, very juicy, sweet and highly flavoured, thin skinned, pulp and division tissues tough, and the rind a light lemon yellow in colour. Trees growing on lowlands produce an inferior fruit to that found at higher elevations, and generally supply the early portion of the produce exported, on account of their easier accessibility. The orange-tree in Tahiti is not cultivated but grows in the wild state, propagation being carried on by raiders, such as rats, &c., scattering the seed, which, owing to the moist, warm climate, germinates with certainty and rapidly. With few exceptions, occasionally found on clearings made for dwellings, plantations, and roadways, the orange-tree in Tahiti grows in the bush, straggling, moss-covered, enveloped by tendrils and creepers, and surrounded by weeds, and in this naturally weakened condition is becoming an easy prey to the many species of scale and insect pest now so prevalent. The more vigorous trees found in the open are better able to resist the ravages of this evil, but the consequences in course of time to the so-called orange groves of Tahiti, must be evident to all. The native, however, who so greatly depends on the orange crop as a source of income, does nothing whatever to save the trees. He makes no attempt to clear the chaos of jungle surrounding them, or to destroy the pest. He contents himself with simply living on the fruits of nature as long as they are provided for him. Consul Hawes says that it is perfectly possible and practicable to make the culture of the orange in Tahiti a success, and the present condition of inactivity if continued must bring disastrous results. To regain the markets of California, and to retain those of New Zealand, will necessitate attention being given to the cultivation of the orange-tree.

THE CIGARETTE INDUSTRY IN EGYPT.

The United States Agent and Consul-General at Cairo, in a recent report, says that the "Egyptian cigarette" is strictly speaking, a misnomer, for the cultivation of the tobacco plant has been forbidden by decree since 1890, hence "cigarettes made in Egypt" would be a more correct description. The manufacture is an important one, however, and is doing something towards materially increasing the revenue of the country. Nearly all the tobacco comes from Turkey, where it is shipped chiefly from Cavallo, Latakia, and Yenidge. The paper comes from Austria, Germany, and Italy, and the greater part of the labour employed is Greek, except for common brands, which are made by the natives. The manufacture for export is very largely in the hands of the Greeks, and so deeply founded is

the belief that Europe and America will buy only Egyptian cigarettes made by a Greek firm, that several manufactories are stated by the United States Consul to be carried on under trade names invented or borrowed in pursuance of this strange belief. The total exports of cigarettes in 1893 was about 140,000,000 in number, valued at something over £233,000. The bulk of the trade is centered in Cairo, where there are no less than eighty-three manufacturers for export, who employ thirteen hundred workmen. Taking into account the families of these people, it may be estimated that at the very least five thousand inhabitants of the Egyptian capital are dependent for their daily bread on this industry. The Egyptian cigarette has such an established position that it is difficult to believe that this flourishing trade is of very recent growth, but it is in fact one of the many indirect advantages accruing to the country from the impetus imparted by the invasion of foreign enterprise. The constant flow of tourists has been an important means of disseminating the taste for the Egyptian cigarette, acquired in the land of the Nile, and its delicate aroma is familiar in consequence, not only in Europe and America, but in remote corners of the earth. The Cairo manufactured cigarette is valued above all others made in Egypt. The same tobacco may be used and as skilful workmen employed in other places, but the same delicacy of flavour is not obtained. It is claimed by experts that the cause of the superiority of the Cairo cigarettes is the very dry climate, which is better adapted to their manufacture than is the humid air of seaport towns. Notwithstanding Cairo's claim to climatic advantages, Alexandria has a considerable cigarette trade, and Port Said drives a profitable trade with ships constantly passing through the Suez Canal. The tobacco used is not adulterated in any way, it is claimed, but is skilfully blended to acquire the desired strength and flavour. The best leaves are selected for use in export, common grades being consumed in Egypt, where nearly every man, woman, and child, is a smoker of cigarettes, and a pipe is hardly ever seen in the mouth of a native. The Custom-house returns show that of the tobacco entering the country, only about one third is exported. Machinery is not employed in any way, except for cutting the tobacco, and it is said that the workmen wield sufficient power to render machinery for rolling a step too dangerous to be contemplated. Adept workmen are paid from five shillings and two pence to six shillings per thousand for rolling. All tobacco entering Egypt pays a duty of four shillings and two pence per kilogramme (kilogramme = 2.204 lbs. avoirdupois) and a drawback of two shillings per kilogramme is allowed on cigarettes sent out of the country. England is the largest customer for Egyptian cigarettes, with Germany next. Wholesale prices range from one pound to two pounds sterling per thousand, while a few fancy brands bring as much as three pounds fifteen shillings a thousand. Consul Penfield says that to protect the public and the maker

against spurious imitations of Egyptian cigarettes manufactured in Europe, the Egyptian Government is about to issue an official label which will be affixed to each box of cigarettes made in, and exported from, the country.

MANILA HEMP AND TOBACCO.

Two of the chief vegetable products for which Manila is celebrated are its so-called hemp (*Musa textilis*) and the well-known Manila cigars. Referring to the former, the British Consul, in a report to the Foreign-office, dated from Manila in April last, says there was a decrease in the export during the past year below that of 1892 of 149,037 bales, or 17,604 tons. The year 1892, however, was noted as that in which the greatest quantity of hemp was exported from the Philippines since the superiority of Manila hemp has been recognised in the English and American markets. The commerce in this article—the chief product until lately of the islands—has almost entirely in recent years been in the hands of the English merchants, owing to their reliance on the superiority of Manila hemp and its ready acceptance by foreign purchasers. The producers in the province, however, formerly forwarded their hemp to the capital insufficiently dried, and in an otherwise unprepared state, and frequent complaints from purchasers were received of the deteriorated quality of the hemp. Alarmed at the danger thus threatening the reputation of Manila hemp, the chief export houses of Manila united together, and published a circular, by which they bound themselves not to purchase hemp, except of a specified quality as to weight, colour, &c., and arranged that, in case of disagreement as to the quality of the purchasable article, the hemp should be submitted to the judgment of experts, and all the signatories bound themselves to observe the condition of the circular. The effect of this circular has already been felt in the improvement of the quality of hemp produced for export, an improvement which is likely to continue. There is a large decrease of the hemp exports to the United States and Canada, amounting to 17,613 bales, while there is an increase to Great Britain, Australia, China, and California.

Manila cigars, it seems, go in largest quantities to China, Japan, and India, to the extent of 68,328, or about half of the whole quantity exported. Great Britain and the continent of Europe take nearly all the remainder, only small portions going to Australia, California, and the United States. By far the greatest quantity of tobacco leaf is shipped to Europe, and principally to Spain, where it is worked up in the Government factories into cigars and cigarettes.

SERICULTURE IN BULGARIA AND EASTERN ROUMELIA.

The *Journal de la Chambre de Commerce de Con-*

stantinople says that sericulture in Bulgaria, as well as in Eastern Roumelia, had attained a considerable degree of development as far back as 1868, and a vast extent of land was devoted to the growing of mulberry trees. Since that period, however, the pebrine, which raged all over Europe, injuriously affected the mulberry trees, and caused various maladies to the silkworms, to such an extent as almost to kill the industry. About five or six years ago, however, the Government of the Principality took active steps to revive sericulture, and supplied the population with silkworms eggs, selected after the Pasteur method. In 1890, the Government distributed 2,000 ounces of eggs, from which 60,174 kilogrammes (132,382 lbs.) of cocoons were obtained, representing a value of 174,510 francs (about £7,000); in 1891, 6,537 ounces were distributed, from which 165,650 kilogrammes (364,430 lbs.) of cocoons, valued at 331,300 francs (about £13,000) were obtained; in 1892, 7,520 ounces, yielding 222,100 kilogrammes (488,620 lbs.), valued at 622,100 francs (£25,000) were distributed; and, finally, in 1893, 11,000 ounces, producing 440,000 kilogrammes (968,000 lbs.) of cocoons, valued at 1,276,000 francs (£51,000). The centres of the sericulture are Stanimaka and Perouschitza, which obtain the eggs from Asia Minor and Vratza, where French and Italian eggs are preferred. In the centres above mentioned, the average yield of cocoons from an ounce of eggs is from 45 to 50 kilogrammes (from 99 to 110 lbs.), while at Vratza and its environs the amount is only from 25 to 30 kilogrammes (55 to 66 lbs.). Beyond these principal centres of sericulture silkworms' eggs are reared, but only in comparatively small quantities, in the towns and villages situated on the northern side of the Rhodope, from the Kritchym river to Harmanly, or nearly throughout the whole extent of the Sredna-Gora; on the two slopes of the Balkans, from the Kamtchyk to Tchiprovtzi, and from Slivno to Klissoura.

Obituary.

HENRY FAIJA, M.I.C.E.—Mr. Henry Faija, a member of the Society of Arts, of nearly 20 years' standing, died at his residence at Sunbury on the 21st August last. He was born in London in 1844, and educated at University College School. He was articled to a firm of shipbuilders on the Thames, and after occupying positions in various shipbuilding yards in the north of England, he started in practice in London as a civil engineer in 1870. He made a special study of Portland cement, and about 1875 he established a Portland cement testing room and laboratory at Westminster. He was the author of "Portland Cement for Users," first published in 1881, and afterwards reprinted,

Journal of the Society of Arts.

No. 2,185. VOL. XLII.

FRIDAY, OCTOBER 5, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

PRIZE FOR DESIGN FOR A SILVER CUP.

The Council of the Society are prepared to award a prize of £25 for the best design for a silver cup. The design, if adopted, will be used for the Swiney prize, which, under the will of the late Dr. Swiney, is awarded every five years by the Society for "The best published work on Jurisprudence." The value of the cup is £100. The offer is open to all students of schools of art in the United Kingdom. Competing designs should be sent in not later than the 31st December, 1894, addressed to The Secretary, Society of Arts, Adelphi, London. They may be sent in under a motto, or in the competitor's name, as preferred. Any design for which the prize of £25 may be awarded will become the property of the Society, to be used as the Council of the Society may direct. The Council reserves the right of withholding the prize, or of awarding a smaller amount, if it should see fit.

PRIZES FOR DESIGNS FOR FURNITURE.

The Council of the Society of Arts hold a sum of £400, the balance of the subscriptions to the Owen Jones Memorial Fund, presented to them by the Memorial Committee, on condition of their spending the interest thereof in prizes to "Students of the Schools of Art, who in annual competition produce the best designs for household furniture, carpets, wall-papers, and hangings, damasks, chintzes, &c., regulated by the principles laid down by Owen Jones."

The prizes will be awarded on the results of the annual competition of the Science and Art

Department. Competing designs must be marked "In competition for the Owen Jones Prizes."

No candidate who has gained one of the above prizes can again take part in the competition.

The next award will be made in 1895, when six prizes are offered for competition, each prize to consist of a bound copy of Owen Jones' "Principles of Design," and the Society's Bronze Medal.

Miscellaneous.

BRITISH FORESTRY.

At the present time, when renewed attention has been drawn to the need for a more extended cultivation of timber (see *ante* pp. 788, 810, 837), it may be found interesting to consider the means which have been taken in this country for the purpose of obtaining an improved supply of timber at two important periods of our history. At the Restoration it was found that, during the Civil wars, the country had been denuded of trees, and John Evelyn was employed to report on the remedies for the serious deficiency of wood. The result of this inquiry was the publication of the diarist's renowned work entitled "Sylva," which revived the spirit of planting in England, and exerted an enormous influence upon the future of the country.

In the middle of the 18th century another period of scarcity occurred, and the newly-founded Society of Arts set itself the task of encouraging the increase of plantations, and this encouragement had such marked success that, within a few years, some millions of trees were planted by the landed proprietors in all parts of the country.

After the Restoration considerable attention was directed to the increase in the number of our ships, and the principal officers and Commissioners of the Navy-office found much difficulty in obtaining the timber which they required for this purpose. Readers of "Pepys's Diary" will remember how much trouble that energetic public servant had in appeasing the anger of Lord Chancellor Clarendon, when the Navy-office cut down a large number of trees in his newly-acquired property of Clarendon-park, Wiltshire. In their difficulty, the officers of the Navy submitted certain queries to the Royal Society, who gave them to Evelyn to answer. On October 15, 1662, "Mr. Evelyn read his paper, in which he had put together the several suggestions offered by others in distinct papers, by way of answer to the queries of the Commissioners of the Navy, together with his own observations and apprehensions concerning the propagation of timber trees."

The paper was ordered for printing, but fifteen months elapsed before the complete work appeared in 1664, under the title of "Sylva: or a Discourse of Forest Trees and the Propagation of Timber in his Majesty's Dominions." This work is a storehouse of all kinds of information relating to trees, in which facts and legends are mixed together, so that lovers of a scientific method may be inclined to object to its form. In spite, however, of the miscellaneous character of the contents, it is a book that will never be out of date, because it is pervaded by a spirit of enthusiasm for a grand object which cannot fail to inflame the mind of the reader. The plan adopted by the author is to first describe each important tree, and then to give general precepts on planting, and hints, interspersed with anecdotes, on the best modes of procedure. The work went through five editions, the last of which appeared in 1729; and in his dedication to Charles II., the author says:—"Many millions of timber trees have been propagated and planted at the instigation and by the sole direction of this work." In the latter half of the 18th, and the beginning of the 19th century, Evelyn's book renewed its life under the editorship of Dr. A. Hunter, and went through another five editions. In addition to these, an abridgment of the work was published at Keighley in 1827. Dr. Wotton, when setting modern before ancient learning, in his famous "Reflections," declares:—"It may, therefore, perhaps be esteemed a small character of Mr. Evelyn's discourse of forest trees to say that it outdoes all that Theophrastus and Pliny have left us on that subject; for it not only does that and a great deal more, but contains more useful precepts, hints, and discoveries upon that now so necessary part of our *Res Rustica*, than the world had till then known, for all the observations of former ages. To name others after him would be a derogation to his performance." Isaac Disraeli ends a glowing description by saying—"Inquire at the Admiralty how the fleets of Nelson have been constructed, and they can tell you that it was with the oaks which the genius of Evelyn planted."

In the introduction to his work, the author refers to the causes which had brought about the scarcity of timber. He writes:—"It has not been the late increase of shipping alone, the multiplication of glass works, iron furnaces, and the like from whence this impolitic diminution of our timber trade has proceeded, but from the disproportionate spreading of tillage, caused through that prodigious havoc made by such as lately professing themselves against root and branch . . . were tempted not only to fell and cut down but utterly to extirpate, demolish, and raze, as it were, all those many goodly woods and forests which our more prudent ancestors left standing for the ornament and service of their country." In a later portion of his work, the author points out that this wholesale destruction is not necessary even where much timber is cut down, and he writes:—"I read of one Mr. Christopher Darell,

of Newdigate, a Surrey gentleman, that had a particular indulgence for the cutting of his woods at pleasure, though a great ironmaster, because he so ordered his works that they were a means of preserving even his woods, notwithstanding those insatiable devourers. This may appear a paradox, but it is to be made out, and I have heard my own father (whose estate was none of the least wooded in England) affirm that a forge and some other mills, to which he furnished much fuel, were a means of maintaining and improving his woods; I suppose by increasing the industry of planting and care, as what he left standing of his own planting, enclosing and cherishing . . . sufficiently evince." The author then goes on to urge princes, dukes, earls, lords, knights, and gentlemen to encourage and animate the glorious work of repairing the havoc that had previously been worked. He paraphrases the words of Nehemiah after the Jewish captivity, and cries, "Let us arise and plant." He enforces his argument, by what he had read, "of a certain frugal and industrious Italian nobleman, who, after his lady had been brought to bed of a daughter (considering that wood and timber was a revenue coming on whilst the owners were asleep), commanded his servants immediately to plant in his lands, which were ample, oaks, ashes, and other profitable and marketable trees, to the number of an hundred thousand, as undoubtedly calculating that each of those trees might be worth twenty pence before his daughter became marriageable, which would amount to 100,000 francs (near ten thousand pounds sterling), and this he intended to be given with his daughter for a portion. This was good philosophy, and such as I am assured was frequently practised in Flanders upon the very same account."

There is a general feeling that the planter plants for posterity and not for himself, so that it was not easy for Evelyn to instil his own enthusiasm into others; but he enforced his arguments with such examples as he could find, and pointed to the aged father of Ulysses, who planted against the time his son came home. In the end he was successful and the King publicly thanked him at Court for his patriotic endeavours to benefit his country. His pleasure at the success of his work was his sole reward, for he gave up the profits of publication, and when he begged a favour he was refused. He himself relates this curious incident in a letter to Lady Sunderland in 1690, as follows:—"His late Majesty Charles II. was sometimes graciously pleased to take notice of it to me, and that I had by that book alone incited a world of planters to repair their broken estates and woods which the greedy rebels had wasted and made such havoc of. Upon this encouragement I was once speaking to a mighty man then in despotic power, to mention the great inclination I had to serve his Majesty in a little office, then newly vacant (the salary I think hardly £300), whose province was to inspect timber trees in his Majesty's forests, &c., and take care of their culture and improvement, but this was conferred upon another who

I believe had seldom been out of the smoke of London, where though there was a great deal of timber there were not many trees. I confess I had an inclination to the employment upon a public account as well as its being suitable to my rural genius, born as I was at Wotton among the woods." Sayes Court, Deptford, where Evelyn exercised his taste for planting and gardening, and which Roger North described as an exemplar of the owner's book on "Forest Trees," has been destroyed, but the beautiful seat of Wotton still remains as sequestered as ever, and is still glorious with the magnificent trees planted by John Evelyn and his tree-planting family. Here may be seen enough to show that its owner deserved the name of Sylva Evelyn, both on account of his literary and his practical labours.

Years passed, and the enthusiasm stirred up by Evelyn died away, but in the middle of the 18th century the Society of Arts arose to revive the action that had been widely spread in the previous century. The denuded condition of many of the Royal forests, as well as of private estates, again excited a general alarm lest a serious deficiency should occur of oak timber of native growth, adequate to the increasing demands both of the navy and of the mercantile marine. Medals were offered for plantations of forest trees, and in the year 1758 the medals began to be claimed. In that year the Duke of Beaufort received the large medal for 20 acres, called the Back Warren, in the parish of Hawksbury, in the county of Gloucester, sown with acorns alone, in the proportion of four bushels per acre, in the winter of 1757, and the spring of 1758. Every year, for a long period, these medals were awarded, and in some years several were given. Mr. Matthew Lee, of Elsford, near Exeter, received the large silver medal, in 1761, for planting 6,000 four-year-old firs; also Weymouth pines, spruce firs, &c.; and for sowing a considerable quantity of acorns. In the same year, Mr. Denys Rolle received the large gold medal for planting on his manor of Chettlehampton 3,394 Scotch firs of above two years' growth, and for planting at East Tuderley 8,000 Scotch firs of above two years' growth. Mr. Robert Sutton received the large silver medal for planting 19,500 Scotch firs in 1759, and 4,500 of the same in 1760. William Beckford, the celebrated lord mayor, received a gold medal in 1769 for planting 61,800 Scotch firs. Lord Scarsdale received the large silver medal for 40,000 oaks, 17,700 Scotch firs, and 15,000 other forest trees; also 18,000 Scotch firs above five years old, planted at Keddleston, county of Derby, in 1765. The Earl of Winterton received medals in 1761, 1767, and 1775; the Duke of Bedford in 1761 and 1763; and the Earl of Moray in 1767.

In a few years, the Society had awarded medals for the plantation of some millions of trees. In the plantation of such large numbers, the results may not always have been so satisfactory as they would have been had the more scientific methods which are

now taught been practiced. The late Lord Houghton, referring to the trees planted at Fryston by his grandfather (Richard Slater Milnes), for which he received medals in 1789 and 1790, said that the larches and firs were not altogether satisfactory as plantations, but that the beeches were by far the most productive.

How necessary was the renewal of the timber trees of the country may be seen at once by one instance of destruction that occurred during the period of the great war with France. In 1724 a magnificent double avenue of walnut trees was planted on the Park-lane side of Hyde-park, which extended from Cumberland-gate almost to Hyde-park-corner. About 1,800 of these trees were cut down, to make stocks for soldiers' muskets, and one of the chief ornaments of the park was thus ruthlessly destroyed.

In the second half of the 18th century, the principles of the science of forestry were laid down by certain German foresters; and one of them (Hartig) founded, in 1800, the school of Dillenberg, in Nassau; but it was not until 1824 that the French took the matter up seriously, and founded the Forest School at Nancy. The earliest forest operations in India have been traced to Bombay, by General John Michael (see *Journal* vol. xxxviii. p. 905). The Government, by proclamation, assumed forest rights as far back as 1807, appointed Commissions to fix boundaries, and attempted a scheme of conservancy, which, however, was abandoned in 1822. It is not necessary here to refer further to the great work which has been done in India.

In Great Britain renewed attention was drawn to the denudation of the earth's surface of its forest covering, at the Edinburgh meeting of the British Association in 1850. A committee was appointed to consider the report, and the discussions that grew out of it led to the organisation of the Indian Forest Administration, in 1855. Again, in 1894, a warning note has been raised at the meeting of the British Association at Oxford, by Prof. Isaac Balfour, as to the present unsatisfactory condition of the forests of the world.

In 1882, the Council of the Society of Arts transmitted to the Secretary of State for India a memorial in which they impressed upon the Indian Government the necessity for the establishment of a department for the teaching of forestry in the Royal Engineering College at Cooper's Hill (see *Journal*, July 14, 1882, p. 879). Three years afterwards, in 1885, the Forest School at Cooper's Hill was established.

ELECTRICAL MEASUREMENT.

The Electrical Standards Committee have issued the following final report:—

Since the date of our last report the Board of Trade have laid before us a *resumé* of the action of the International Congress held in Chicago in August,

1893, to determine the units of electrical measurement. We are also informed by the Board of Trade that her Majesty's Government had been invited by the United States Ambassador in London to take steps to adopt the recommendation of the congress. These recommendations, so far as they refer to the units of electrical resistance, electrical current, and electrical pressure, are substantially the same as those suggested for adoption in our previous reports. We see no reason for further delay in the legislation of standards of the above-mentioned units, and we have prepared and attach a revised draft Order in Council, which we advise may be submitted for her Majesty's gracious approval. The accompanying notes to the specification for the Clark's cell have been communicated by Mr. Glazebrook, and will be found of great assistance in the preparation of this form of cell.

COURTENAY BOYLE.

RAYLEIGH.

KELVIN.

G. CAREY FOSTER.

FRANCIS J. S. HOPWOOD.

R. T. GLAZEBROOK.

P. CARDEW.

J. HOPKINSON.

W. H. PREECE.

W. E. AYRTON.

T. W. P. BLOMEFIELD, *Secretary.*

August 2, 1894.

After giving the notes and the revised draft Order in Council, referred to above, the report sets forth the new denominations of standards for electrical measurement as follows:—

1. *Standard of Electrical Resistance.*—A standard of electrical resistance denominated one ohm being the resistance between the copper terminals of the instrument marked "Board of Trade Ohm Standard Verified 1894" to the passage of an unvarying electrical current when the coil of insulated wire forming part of the aforesaid instrument and connected to the aforesaid terminals is in all parts at a temperature of 15.4 deg. C.

2. *Standard of Electrical Current.*—A standard of electrical current denominated one ampère being the current which is passing in and through the wire forming part of the instrument marked "Board of Trade Ampère Standard Verified 1894" when on reversing the current in the fixed coils the change in the forces acting upon the suspended coil in its sighted position is exactly balanced by the force exerted by gravity in Westminster upon the iridio-platinum weight marked A and forming part of the said instrument.

3. *Standard of Electrical Pressure.*—A standard of electrical pressure denominated one volt being one hundredth part of the pressure which when applied between the terminals forming part of the instrument marked "Board of Trade Volt Standard Verified 1894" causes that rotation of the suspended portion of the instrument which is exactly measured by the coincidence of the sighting wire with the image of the fiducial mark A before and after application of the pressure, and with that of the fiducial mark B during the application of the pressure,

these images being produced by the suspended mirror, and observed by means of the eye-piece.

In the use of the above standards the limits of accuracy attainable are as follows:—For the ohm, within one hundredth part of one per cent.; for the ampère, within one-tenth part of one per cent.; for the volt, within one-tenth part of one per cent.

The coils and instruments referred to in this schedule are deposited at the Board of Trade Standardising Laboratory, Richmond-terrace, Whitehall, London.

A note is appended stating that an Order in Council, in the form given in the report, was made by her Majesty on August 23, 1894.

NEW ZEALAND DAIRY INDUSTRY.

The *New Zealand Trade Review* for the 12th July calls attention to the development of the dairy industry of New Zealand. It states that the colony may be now fairly said to be alive to the importance of this industry, and the number of factories is on the rapid increase. The following are the numbers of factories and creameries existing in New Zealand at the present time:—

	Factories.	Creameries.	Total.
North Island....	70 ..	40 ..	110
South Island....	48 ..	20 ..	68

The total is 178, against 104 in June, 1893, and 72 at the same time in 1892. Several more are in course of erection in both islands.

The Government is also in earnest in its efforts to encourage and promote the industry, which they see to be a potent factor in the settlement of the land. The number of instructors appointed by the department has been increased from two to six, three of whom will work in each of the two islands.

A Bill, to be promoted in Parliament by the Government this session, will provide for the erection of cool storage at the four chief ports of shipment—Auckland, Wellington, Lyttelton, and Dunedin. This is a most important step. It also provides for a system of inspection and grading of butter before shipment.

One by one improvements are being introduced in the conditions under which the trade is being carried on. Dairy associations are being formed where none existed before, and the various associations in the two islands, while maintaining their separate organisations, are combining their forces to take joint action for the common good of the trade in respect of such things as cool storage, rates of freight to England, proper care on the voyage, and so forth.

The Union Steam Ship Company has just decided to have one of their coasting steamers fitted with refrigerating machinery, with the view of employing it in taking butter from the smaller ports to the larger ones for transhipment into the steamers loading for England.

Together with the recent agricultural returns, particulars were obtained of the number of cattle and breeding cows held in New Zealand, from which we extract the subjoined figures, adding comparison of the totals for previous years :—

	North Island.	South Island.	Total.
Cattle, 1894.....	613,454	270,637	884,091
Breeding cows, 1894	218,238	109,374	327,612
Cattle, 1893.....	557,566	250,873	808,439
Breeding cows, 1893	199,470	105,800	305,270
Cattle, 1891 (census year).....	—	—	788,919
Breeding cows, 1891	—	—	280,711
Cattle, 1886 (census year).....	—	—	853,358
Breeding cows, 1886	—	—	279,136

Between 1886 and 1891 the number of our cattle had actually fallen off, and from 1891 to 1893 the increase was slow. The attention being now paid to the dairy industry is naturally resulting in a substantial increase in the number of cattle. It will be seen that nearly 70 per cent. of the cattle are in the North Island, and that the rate of increase is also rather heavier there than in the south. In 1893 the proportion of breeding cows to the whole number of cattle was fully 37 per cent., whereas in 1886 it was under 33 per cent. The number of breeding cows is in each case included in the number of cattle.

Shipments of butter and cheese from Wellington for the United Kingdom for the two years ending 30th June, 1894 and 1893 respectively, were as follows:—

	1893-4.	1892-3.	Increase.
Butter—Tons.....	2,498 ..	1,191 ..	1,307
Cheese „	720 ..	325 ..	395

—Board of Trade Journal.

SOIL INVERTING PLOUGH IN INDIA.

The following note is from a report on “the Dumraon Farms: what they teach,” by Mr. B. C. Basu, Assistant to the Department of Land Records and Agriculture, Bengal.

Different kinds of inverting ploughs have been used on the Dumraon farm; but they are all built on the same principle. They are, generally, made wholly of iron, and fitted with a broad curved piece called a mould board, which inverts the furrow slice, that is, turns it upside down. The beam is of wood, like that of the country plough, and is connected with the yoke in the usual manner. The ones in use on the farm go just as deep as the native implement. It is said that soil-inverting ploughs are too heavy of draught for country bullocks; but the idea is unfounded, as on the farm they are drawn by cattle

with the same ease as the country plough. In fact, the farm ploughmen prefer to plough with the former.

To compare the soil-inverting with the country plough, two plots, each 800 square yards (a little over 5 local cottahs), were ploughed up and both cropped with wheat, and treated exactly alike in all other respects. The cost of cultivation was the same in both plots. The increase in out-turn, obtained by means of the inverting plough, over the out-turn obtained by means of the country plough is shown below:—

	Grain per acre.		Straw per acre.	
	Increase.	Decrease.	Increase.	Decrease.
	Mds. s.	Mds. s.	Mds. s.	Mds. s.
1885-86.....	2 16	..	3 21	..
1886-87.....	1 14	..	1 8	..
1887-88.....	1 35	..	..	0 14
1888-89.....	1 4	..	1 35	..
1889-90.....	2 4	..	4 16	..
1890-91.....	0 30	..	0 19	..
Average..	1 24	..	2 12	0 14

Both the plots having been continually under wheat for several years, and received no manure, their out-turn was gradually decreasing. In 1891-92 it was, therefore, thought desirable to change the crop; and the experiment was, accordingly, discontinued on the two plots which had been hitherto reserved for the trial. It was, however, made on two other plots, with the result that the inverting plough gave 1 maund 26 seers of grain, and 3 maunds 1 seer of straw more per acre than that of the country plough. The result leaves no doubt that the out-turn of wheat can be increased to a certain extent by the use of the soil-inverting plough.

The effect of soil inversion was equally conspicuous on paddy. The trial with this crop was carried out in exactly the same way as with wheat. The results are shown in the following statement:—

	Increase of grain per acre.		Increase of straw per acre.	
	Mds. s.		Mds. s.	
1886.....	1 6	....	8 16	
1887.....	0 35	....	2 38	
1888.....	1 8	....	2 8	
1889.....	3 8	....	6 2	
1890.....	0 24	....	3 20	
Average..	1 15	....	4 33	

The experiments are specially instructive, and may dispel the generally accepted idea as to the unsuitability of soil-inverting plough in India.

Dr. J. W. Leather, Agricultural Chemist to the Government of India, informs the editor that “at Cawnpore an improved plough, having an iron share, and ploughing 5 inches deep, has been tested against the country plough since 1881. Six years’ experi-

ments, during four of which they were made in duplicate, showed, with one exception, a distinct increase in the cotton crop; and eight years' experiments, of which seven were made in duplicate, and in which wheat was the crop, showed, with one exception an increase, apparently due to the improved plough.

"Leaving out of consideration the actual increase obtained, which varied considerably, it must be remarked that, assuming no effect on the crop, there is still a saving of half the labour. The improved plough is drawn perfectly well by even a 'small' pair of bullocks, and the number of ploughings necessary is reduced to half."—*Agricultural Ledger Series*, 1893, No. 11 (*Calcutta*).

ARTIFICIAL FLOWER-MAKING IN PARIS.

Artificial flower-making, which is essentially a French, and above all a Parisian, industry, is one of the oldest in the country. Since the year 1770, this industry has been a flourishing one, and, at the present time, the manufacture of artificial flowers comprises an infinity of specialities which differ very widely one from the other. M. Alexis Audouard, in a communication to the *Monde Economique*, says that in the first rank are the florists, properly so-called. It is they who make up the flowers, the petals, and the branches, and these workpeople are divided into two classes—the workers in stuffs and the workers in paper. The former either dye their own stuffs, which are generally muslins and silks, cottons, &c., or have them dyed expressly for them, and then these articles, which form the basis of the artificial flower manufacture, are made up by skilful workwomen. The manufacturers of the ordinary common paper flowers buy their paper ready coloured, and then cut it up, goffer it, and prepare it at their own houses. Side by side with these people, who manufacture all kinds of flowers, there are others who only make up particular kinds. For example, the *rosiers* devote themselves exclusively to making roses, and even this class is considerably subdivided, some occupying themselves in the manufacture of red roses, some of white, and some of yellow; while the manufacture of rosebuds is a speciality with others. The *verduriers* are solely engaged in imitating grass, berries, and flower stems; the *marchands d'apprêts* make and sell to the florists the calyx, pistils, and buds, and prepare the fruit, leaves, &c. The raw materials employed in the manufacture of artificial flowers are very numerous, and vary according to the different parts of the flowers themselves. For the petals, jaconet, cambric, taffetas, satin, muslin, gauze, and crape are employed; for the leaves, taffetas, velvet, plush, and satin. The following are also used for the different parts of the flowers:—Silk cocoons, which take a brilliant colour in the dye; whalebone, cut in strips and bleached; ribbons, feathers, leather, wax, paper,

and iron and brass wire. The tools of which the makers of imitation flowers almost exclusively make use are five, namely, the *pince, boules de bois ou de fer, pied de biche, découpoir*, and the *gaufroir*. The *pince*, or pincers, are indispensable for use in taking up all the different pieces of stuff which go to make up the flower. It is in holding the pincers on their side that the striæ of the petals of many of the flowers are traced, and it is with the head of this instrument, dipped in gum, that the most delicate parts are fixed. The *boules* is a tool with a handle terminated by a shank, at the end of which is a ball. This instrument is used in rendering the petals of the flower which it is desired to imitate, concave or convex. The number of balls used is from ten to twelve, and the diameter varies from 2 to 35 millimetres; the smallest is called the "pin's head." The *pied de biche* is a tool which is used very extensively in artificial flower-making, and chiefly in forming the principal nerve of some of the petals. The *découpoir*, or cutting-out machine, is used in shaping the petals and leaves, and giving them a natural appearance. Each plant requires as many *découpoirs*, of different sizes and forms, as it has petals and leaves. Finally, the *gaufroir*, or goffering-iron, is used in imitating on the leaves the natural nerves and swellings. The manufacture of artificial flowers necessitates four principal operations. First, the cutting-out, then the goffering, the putting together, and, finally, the mounting. As regards the composition of the different parts of the manufactured product, the stem is composed of an iron wire surrounded by cotton thread and covered with paper. For very fine flowers this wire is covered with caoutchouc. The heart of the flower varies according to the nature of the flower itself. To make it, silk threads are generally used which have undergone a special manipulation, and have been tipped with various pastes and colouring materials. The buds and pistils are generally made in paste of a colour as closely approximating to nature as possible. The stem of the bud is of cotton thread or cotton, which is dipped into a trough containing a paste of coloured starch. Finally, the petals are made of calico or madapolam. In the preparation of the raw material, the following is the system adopted:—When the stuff intended for use, and which is to be cut up, arrives at the factory it receives, by the aid of a small brush, an application of starch and gum, more or less coloured, according to the purposes for which it is intended. When it is dry, the pieces are folded together and cut up, and the petals are formed. When a certain number of petals are made, they are passed to another operator to soak them, and to impart the necessary shade. The operation of soaking is a very delicate one, and it varies according to the quality of the flowers. Most frequently, after having plunged the petals for an instant in pure water, the operator removes the superfluous moisture by the aid of blotting-paper; he then spreads them on a cushion and drops gently on each one a small quantity of

colouring matter, which he spreads either with a paint brush or with his finger. The soaking is generally completed by applying to the petals a mordant which fixes the colour. They are then dried in a stove, a careful examination and selection is made, and they are placed in boxes, and these boxes, containing about a gross of petals, are given to the workwomen entrusted with the duty of making-up the flower itself. Each woman has before her, on a table, some iron wire, a small pot containing liquid gum arabic, some wadding, the boxes referred to above containing the petals themselves, and, finally, the tools, which have been also referred to above, and with these the work is done.

INDUSTRIAL PROSPECTS IN CHINA AND JAPAN.

It is well-known that for a long time there has been a large export trade from Shanghai to Europe in straw plait or braid, and it was only last year that a new feature in this article began to develop itself in using split straw instead of whole straw. In Chefoo, it is stated, the plaiting of split straw was somewhat fully adopted during the year. Brass cutters for splitting the straw were introduced into the district some few years ago. There is every indication that the trade in split straw might be made a very large one. The great disadvantage of the Chinese straw is that it is much heavier than European or Japanese straw. This disadvantage would be, to a great extent, overcome if the Chinese would take pains to put on the market a braid from split straw. However, it seems to be an almost impossible task to make the native straw-braid merchants see how much they would gain by carrying out the wishes and instructions of the foreigners engaged in the braid trade. Split braid packs easily; that is, one bale of it contains four times as much as a bale of whole straw braid. The texture of the braid is much finer, and by splitting, if done with care, the whole available straw can be utilised. It seems as if what is necessary is the establishing of a large local factory, or even several factories, where the straw could be plaited under supervision, and access to which would be permitted to the foreigners who deal in the trade. As matters stand at present, the foreigner gives his orders under instructions from Europe or the United States, and the Chinese dealer sends the order into the country, and, in the most leisurely way, executes it by employing the villagers in the district to plait the straw: this is largely done in the villagers' own mud huts, and the contractor goes round, after a certain lapse of time, to collect the work from each hut, and the several plaited pieces are then joined together. No wonder the result is a coarse, carelessly-plaited braid. The supervision of experienced

men over natives working in a local factory would do much to restore confidence in the straw-braid trade of China.

This is the opinion of the Consul at Chefoo, which is one of the straw-plaiting districts; and it was fully believed that the defects in the system were on the road to be remedied.

The export of floor-matting from China and Japan has of late years assumed very large proportions, in consequence of the great demand, both in America and Great Britain, for this cool kind of floor covering for summer use. The season of 1893 is said to have opened at Canton at very low prices, at which large contracts were booked; but gradually the market grew firmer, when it became apparent that the unprecedented frost in January had spoilt, to a great extent, the first crop of rushes. At the close of the year, prices were about the average of the past three seasons, and dealers expected that American buyers would book at those rates their early-spring 1894 contracts. It is said that, notwithstanding the increasing production of Japan matting, Canton is sure to hold its own, so long as it maintains a superior quality and workmanship, and remains reliable in its stipulated dates of deliveries.

On the opium imports, and the production of the drug in Tainan, it is stated that the chief foreign import is from Persia, the native drug being too high in price to compete with the Persian produce.

The following peculiar facts are given on the adulteration of native-grown opium:—"Sesamum seed-cake is now quite out of use for opium adulteration, having been supplanted by 'Tientsin' cake, a repulsive preparation of boiled-down skins, and all kinds of gelatinous refuse, to which opium has been added in the boiling, or anything that imitates the taste or smell of opium. The adulteration is yearly increasing, and the price of the so-called 'medicinal cake' has now risen considerably. The cake is mostly imported by foreign vessels, and is sold by the dealers together with each chest of opium. The poorer classes now buy a mixture of nearly equal parts of opium and 'Tientsin cake,' which must be far more injurious than the pure drug."

Turning now to an item from Japan, it seems that in coal and matches the Japanese are active competitors with English producers, having already succeeded in completely ousting English-made matches from the markets in China and the Straits Settlements, a fact not to be wondered at when it is seen that they can export from Japan at a cost little exceeding 8d. per gross. The quality is, however, generally bad, and whatever may be the case now there can be no doubt that in the first instance, at least, Japanese matches obtained an entry into, and favour in these markets, through having boxes in sufficiently colourable imitation of those of well-known English makers to deceive the native purchasers, who regarded only the general appearance of the box and were entirely unable to decipher the inscription. The Japanese coal is now rapidly pushing

its way further westward, and already it is largely used by ships coaling at Singapore. According to the Customs returns about 480,000 tons of coal and 173,000 tons of so-called coal dust were exported in 1893 to Hong-Kong and British India, including Singapore, but to this must be added a large quantity shipped in steamers nominally for ships' use, but in reality for purposes of trade. The value of coals exported amounted to £205,502, and of matches to £135,595.

CLOCKMAKING INSTRUCTION IN THE BLACK FOREST.

Furtwangen, a village of the German Black Forest country, is famous for its school and its clocks. From time immemorial the Black Forest has been famous for some kind of home industry. The isolated lives of its inhabitants, before coach roads and railways were built, led to hand work during the long nights and the dull days of winter, and the clockmaking industry was commenced. Down to the late sixties and early seventies nothing interfered with its success, and about the latter period machinery began to be employed in the manufacture of clocks, and Furtwangen and the Black Forest found themselves powerless to withstand the competition with America in this branch of industry. The Duke of Baden then began to look for the means of reviving the drooping industry, and found what was required in the wood carvings of the Austrian Tyrol, and in a school system calculated to lift clockmaking from a trade to a science. The United States Consul at Chemnitz says that a clock school was opened in 1877, wood carving introduced, and the clockmaking industry generally took a new lease of life. The purpose of the school is to advance the interests of the Black Forest clock industry and to give technical instruction in the mechanical branches associated with the making of clocks, watches, and electrical instruments. Its object further is to train mechanics, masters, and manufacturers. It aids manufacturers in the Black Forest industries by giving advice, assistance, and newly acquired knowledge, especially in the matter of new machines, patterns, movements, &c. The course covers three years, and is divided into three branches, preparatory, clockmaking, and the advanced or supplementary course. It comprises theory and practice, the latter in the workshops in different branches of clock and watchmaking, the higher mechanics and electricity. The preparatory course for clock makers, including the preparation of materials by filing, turning, boring, fixing and making tools, production of parts of watches and clocks, occupies 48 hours a week in summer and 44 hours in winter; for fine and electro-mechanics, filing, turning, forming, running machines, fixing and making of tools and small apparatus used in the finer mechanics, and for treating electricity, 47 hours in summer and 43 in winter; in the clock and watchmaking course and fine mechanics for clock and watchmakers, in the

production, putting together, separating and adjusting works of all kinds, 41 hours in summer and 37 in winter; for fine mechanics and electro mechanics, in the preparation and making of electric clocks, telephones, microphones, compasses, &c., after drawings, 43 hours in summer and 39 in winter. In the advanced course for watch and clockmakers, in the making of clocks and watches for special purposes, chronometers, chronographs, marine watches, clocks, &c., 53 hours per week in summer and 49 hours in winter. The means of instruction include a large collection of all kinds of tools, instruments, drawings, models, &c., and carefully constructed and equipped school premises. Besides these, factories, electric plants, &c., are often visited under the direction of their teachers or of the mechanics employed in the places visited. There is also a library in which most of the books relating to clock and watchmaking, and the technique and mechanics of clock and watchmaking and electricity are to be found. There are illustrations, drawings, implements, tools, &c.; machines for tool making and tool repairing, a reading-room and a room for drawing, which are open to the scholars from 7.30 a.m. to 9.30 p.m., and all day on Sundays and holidays.

PEACH CULTURE IN BELGIUM.

The United States Consul at Liège, in his last report, says that the kingdom of Belgium, after supplying a population of 500 to the square mile, exports 105,000,000 lbs. of fruit. Last year the markets were glutted, and the value of foreign shipments rose to about £600,000. A very large proportion of the fruit shipped consisted of peaches, and of the finest varieties. In fine soil, and in situations protected from the north and north-east winds, peach trees, grown from the seed, have occasionally borne fruit; but to ascertain the best stock upon which to bud, a long series of experiments were tried and tried again upon all the varieties of prune, apricot, sweet and bitter almonds—every tree, indeed, of a kindred nature—till the conclusion was reached that the best stem for grafting is the red plum. This hardy plant, whose roots spread wide and strike deep, imparts much of its own vitality to its foster scions. Grafting or budding is done out of doors, so as not to soften the young tree by accustoming it to unnatural conditions. The next question to be considered was that of soil. In sandy and dry earth it was found that neither the plant nor the peach flourished, the one being spindling and the other small; while in rich and moist alluvial soil the tree prospered at the expense of the fruit. A calcareous soil, neither wet nor dry, is preferred by the peach, the young trees requiring a great deal of lime. As it is impossible to tell, without chemical analysis, the exact amount of this element contained in any given quantity of earth, its application must be more or less experimental. The rule in Belgium is to first

thoroughly fertilise the soil with manure, and then, after planting the tree, to add a peck of lime to every cubic yard of earth, placing it near the surface. As it is necessary to loosen the earth for at least six feet square and three feet deep, this quantity—a bushel to a tree—may seem large, but the authorities are all agreed that more rather than less would be better. The application should be repeated every three years. Turning from the standard tree, which too often failed to be profitable, Belgian agriculturists experimented with *espaliers*, or wooden railings, but these were found to be so open and exposed that the young trees fared very little better upon them than in the orchard. They next tried the wall, not as in some countries, where mural enclosures are built at great expense for the special protection of delicate fruit, but the sunny sides of their houses, and this met with such astonishing success that there are few houses to-day in Belgium upon whose southern exposed sides trees are not trained. No chateau is too grand, and no cottage too humble, to furnish them protection and support. Consul Smith says that last summer he saw ripening upon the gable end of a town house, a surface of about thirty feet square, over 2,300 peaches, and every one of them larger than a hen's egg. There were four trees, two of them with dwarf stems, not more than 12 inches high, and branches 6 feet long, radiating like the ribs of a fan, and two "riders," or bushes grafted upon tall stocks, whose boughs began to spread where the others terminated. At the time of flowering, it is always necessary to shield the buds from the action of frost, and this is done by various methods, the best of which experience has shown to be the placing, among the upper boughs of the trees, of branches cut from other green trees. This plan has been attended by good results, though it should be employed with great caution, as too much shade is apt to stifle the germs, by excluding the rays of the sun. Another method, until recently very much in vogue, and always effective, is the employment of mosquito netting, or other cheap material with meshes large enough to admit the free passage of light and air. The old custom of using closely-woven cloth, like table or bed linen, at night, and removing it in the morning, is said to be more dangerous than the frost itself, as the trees at this season cannot be deprived of air without serious injury. In addition, this artificial heat at night, succeeded by the warmth of the sun, hastens their blowing, when the object is to delay it as long as possible. Shading at noon is sometimes as essential as covering at night. The poor succeed very well in protecting their fruit, by placing a number of horizontal poles about 18 inches apart, and from 4 to 6 inches from the trees, and covering them with light wisps of straw. In good situations, penthouses will sometimes suffice to protect the fruit; in any case, they are extremely useful in checking the flow of sap. Since 1876, the following addition to this method has made assurance doubly sure:—A fringe, made

of unthreshed rye straw, by tying the cut ends of the stalk together with twine or cord, six or eight in a loop, with spaces of about 3 inches between the wisps, is attached to a pole and suspended under the eaves of the penthouse and in front of the trees. The texture being open, it does not prevent the light and air from reaching the buds. These shields are usually placed in position about the 1st March, and are not removed, except in cloudy weather, until all danger from frost has passed.

Obituary.

W. TOPLEY, F.R.S.—Mr. William Topley, who died at his residence at Croydon on the 30th ult., at the comparatively early age of 53, had been for many years a distinguished officer of the Geological Survey. He received his scientific training at the Royal School of Mines, and became attached to the staff of the Survey in the early part of 1862. His first work lay in the Wealden district, and in 1875 his well-known "Memoir on the Weald" was published officially. He afterwards worked for some years on the carboniferous rocks of Northumberland. Mr. Topley gave much attention to economic geology, especially to questions bearing on water-supply. He was for many years Examiner in Geology to the Science and Art Department, and in 1888 was elected F.R.S. In the work of the International Geological Congress Mr. Topley took much interest, and was secretary at the London meeting six years ago. He attended the meeting at Zurich at the end of last August, and immediately afterwards proceeded to Algiers, where, it is believed, he contracted the typhoidal fever which proved fatal. Mr. Topley joined the Society of Arts in 1884, and was a constant attendant at the meetings when subjects connected with geology were discussed. He read a paper on "Water Supply in its Influence on the Distribution of the Population," in 1884, at the Conference of the Society of Arts on the Water Supply, held at the International Health Exhibition; and on April 15, 1891, he read a paper before the Society on "The Sources of Petroleum and Natural Gas."

Notes on Books.

BOOKBINDINGS AND RUBBINGS OF BINDINGS IN THE ART LIBRARY, SOUTH KENSINGTON. Department of Science and Art of the Committee of Council on Education. II. Catalogue. London: 1894. 8vo.

This volume contains a descriptive account of the

collection of bookbindings in the South Kensington Museum, consisting of specimens of English, Scotch, Irish, *Nederlandish*, French, German, Italian, Spanish, Portuguese, and Turkish bindings. There are 325 entries in all, described on 74 pages. The second part of the catalogue, occupying 250 pages, is devoted to a description of the unique collection of rubbings in the Art Library, taken from bindings dating from the 12th century. The most important bindings are illustrated by a plan of ornamentation which enables the reader to follow the description of the book cover. Illustrations are also given of some of the binders' stamps, which are of special interest. A list of the libraries from which these rubbings have been taken is added. Some of the most interesting of the early English bindings come from the cathedral libraries of Durham and Hereford.

TRAVELS IN INDIA A HUNDRED YEARS AGO, WITH A VISIT TO THE UNITED STATES: being Notes and Reminiscences by Thomas Twining, preserved by his son Thomas Twining, and edited by the Rev. William H. G. Twining. London: J. R. Osgood, McIlvaine and Co.

Mr. Thomas Twining was a civil servant of the Hon. East India Company, who went out to India, in 1792, at the age of sixteen. During the voyage out he studied the Persian language so assiduously that when he arrived in India he excited some surprise among the natives, and received the enconiums and attentions of the great Oriental scholar, Sir William Jones. Mr. Twining's health necessitated his leaving India in 1795, but during the three years he was in the country he made numerous journeys, particulars of which are recorded in this volume. The second portion of his Indian life extended from 1798 to 1805, and was mainly devoted to high official duties. Mr. Twining came in contact during his stay in India with many distinguished men, such as Lord Cornwallis, Sir William Jones, Sir Ralph Abercromby, Lord Wellesley, and others, and respecting these great men there are many interesting notes. He never saw Warren Hastings, but he was known by report to the Governor-General, who had a high esteem for him. Between Mr. Twining's two visits to India, he made a voyage to the United States, and a portion of this volume is devoted to a record of some of the incidents of his visit to that country in 1795.

Mr. Twining closed his Indian career in 1805, and settled permanently in England. He died at an advanced age, on December 25, 1861.

HEAT TREATED EXPERIMENTALLY. By Linnaeus Cumming, M.A. London: Longmans, Green, and Co., 1894.

Mr. Cumming, who is a science master at Rugby, has embodied in this text-book the course of instruc-

tion he found useful in his school teaching. His object has been to give "an elementary treatment to the general laws of heat with an account of such experiments as may be performed by the teacher in his lectures or by students in the laboratory," and to treat the theory of heat so far as it can be treated for the benefit of students whose mathematical knowledge does not extend beyond elementary trigonometry.

The elementary portion is very full, and such slightly more advanced parts of the subject as the mechanical equivalent of heat, the dynamical theory of gases, and the conversion of heat into work, are sufficiently dealt with in some of the later chapters.

The value of the book is certainly lessened by the absence of an index.

THE HOME LIFE OF THE ANCIENT GREEKS. Translated from the German of Professor H. Blümner by Alice Zimmern. Cassell and Company.

Professor Blümner has produced an entirely fresh investigation of the manners and habits among the ancient Greeks, drawn directly from the large body of materials—literary, artistic, and epigraphic—which are at the service of the student. The headings of the various chapters will give a good idea of the contents of the work, which is fully illustrated:—Costume, Birth and Infancy, Education, Marriage and Women, Daily Life within and without the Home, Meals and Social Entertainments, Sickness and Physicians, Death and Burial, Gymnastics, Music and Dancing, Religious Worship, Public Festivals, the Theatre, War and Seafaring, Agriculture, Trade and Handicraft, and Slavery. The translator has taken an independent position, and has not made an absolutely literal translation of the original text, and, in a few instances, she has corrected some slight inaccuracies.

PRIMARY SCIENCE. By Thomas Twining. Twickenham: H. and C. Franklin. 1894.

This pamphlet has been prepared by Mr. Twining, whose labours in the cause of technical education are so well known, and have extended over so long a period, with a view of setting out more clearly the subjects which are included in the "Science of Common Things," now included as one of the subjects of the Elementary Education Code. In the code this subject is classified for the first three standards as including object lessons upon animals, plants, and inorganic substances; for the fourth standard, simple mechanical laws, pressure of liquids and gases; for the fifth, simple chemical laws; for the sixth, outlines of physiology; and for the seventh, familiar illustrations of applied science. These headings are further developed by Mr. Twining in his pamphlet.

Journal of the Society of Arts.

No. 2,186. VOL. XLII.

FRIDAY, OCTOBER 12, 1894.

*All communications for the Society should be addressed to
the Secretary, Fehn-street, Adelphi, London, W.C.*

Proceedings of the Society.

CANTOR LECTURES.

ARTIFICIAL FOLIAGE IN ARCHITECTURE.

BY HUGH STANNUS, F.R.I.B.A.

[THE RIGHTS OF REPRODUCING THESE LECTURES IS RESERVED.]

Lecture I.—Delivered February 26, 1894.

CHAPTER I.—INTRODUCTION.

§ I.—

THIS COURSE is intended as an introduction to the study of that Artificial kind of Foliage which was first used in the Greek period, and has since, with various modifications, influenced all subsequent styles of Architectural Art.

It is more appropriate, than Natural foliage, for application to Architecture; for reasons which were given in § 3 of the former Course of Cantor Lectures, which the writer had the honour of delivering in April and May, 1891. *

ARTIFICIAL-FOLIAGE does not suggest any Idea, as Storiatioⁿ does; nor is it imitated from any particular plant, as in the Decorative treatment of *Natural Foliage*. Its existence and use have arisen from the delight, in variegated surface and edge, and in flowing lines, which the Ionians derived from the Assyrians.

THE SERRATED LEAF-EDGE, which is a great characteristic of this foliage, is a result of the dislike of plain or simple edges, which is the itch of decorative artists, as much as the "horror vacui" or dislike of plain spaces.

§ 2.—THE TERM ARTIFICIAL.

The WORDS "Acanthus scroll" have been sometimes vulgarly applied to this kind of foliage; but that is illogical, misleading, and narrow; because (1) the serration of leaf-edge was not adapted

from the *Akanthos* plants but was developed by "Art and Man's device"; (2) it would be absurd to name an entire class of ornamental elements:—flower, stem, leaf, &c., after one detail, *e.g.* the particular method of serration in the leaf-edge; (3) the affixing of the name of one particular plant, to all foliated ornament, would have a tendency to cramp invention and prevent the introduction of further variety.

There were some plants named "*Akanthos*" by the Greeks (in consequence of the *prickly* edge of the leaf); but they are not mentioned, as decoration, before Theocritus (fl. 277 B.C.) who describes the leaves as being used on the handles of a cup.

The Greeks represented certain plants in their decoration; but that was—*storiatio*nally, *i.e.* as symbols; *e.g.* the Ivy and Vine on objects dedicated to Dionysos, or the Olive for Athena. When they had no symbolism to express: then they used Artificial foliage; as



FIG. 1.

may be seen in the Choric Monument of Lysikrates (335 B.C.), one of the roof-ornaments of which is shewn in fig. 1. In this example there is no evidence of imitation of the *Akanthos*.

From that time, onwards, there has always been some kind of foliated enrichment in architecture, which has been *leaf-like* or *plant-like* in general character. It has, however, been imitated from no plant in particular, but deduced and assimilated from observation of the ordinary growth of all such plants in general as the artists of each age possessed and could produce in harmony with their buildings.

Hence the Artificial-leaf has changed in character from age to age; and the great men of each successive Style have re-vivified it by infusing such fresh Nature as they were able to assimilate.

§ 3.—GENERALIZATION FROM NATURE.

ARTIFICIAL-FOLIAGE is a generalised result of the combination of all plants. The Botanist

* *Journal*, vol. xxxix., pp. 859, 874, 905, 917.

may object to this generalisation, and may wish to confine the artist within the narrow grooves of his own Science of observed and recorded phenomena. He might say:—"The leaf of a monocotyledonous plant attached to the flower of a dicotyledon strikes the spectator who has no knowledge of botanical science as unnatural"—but this dragging-in of Science would stifle Art. The Imagination is one of the chief factors in design; and Botanical correctness is not of the highest importance in mere Ornament.

It might further be said:—"If a man may mix-up different plants, selecting what he thinks best from each in order to compound his generalised foliage, may he not do the same thing with animals, using the head of one with the neck of another, and the body, wings, legs, and tail, of others?" To which it may be replied that man *has* done this in nearly all ages. In Egypt and Assyria: animals were often compounded for symbolic reasons; Greece had monsters, *e.g.* the Chimaira, Minotaur, &c.; the Roman artists copied the symbolic forms of their Egyptian and Greek predecessors; but degraded them from symbolism to serve as material for mere æsthetic decoration; even in the two great Christian styles—the Byzantine, and the Mediæval—wings were added, to make Angels and Devils; in the Romance period there were Dragons, &c.; and in the Renaissance times the ornamentists hashed-up again the former Paganism; and ran riot in every conceivable mixture, both of animal and vegetable forms.

Man has been described as a Mixing Animal; and, since "Art is Nature passed through the Alembic of Man", the right, to mix and re-create new types, must be conceded; *always provided that*:—(1) the mixing is frankly confessed, *i.e.* that it does not seek to deceive by too close an imitation of the parts, and (2) the different elements be not so *heterogeneous*, or so *illogically joined*, as to provoke the critical faculty.

§ 4.—A GRAMMAR OF ARTIFICIAL FOLIAGE.

ALTHOUGH the Ornamentist declines to be strictly bound by the Botanist, and prefers to be a law unto himself: still the student should commence by being consistent; and should have some kind of a Grammar.

This is a GRAMMAR of Artificial-foliage. In designing Ornament, which grows in extension, like the Vegetable kingdom—it is impossible to avoid similarity to the plant-forms

in Nature. The points of contact and the analogies are so numerous, that the modern artist, though he strive to be original, is yet only (unknowingly) combining his memories of Nature.

DECORATION, in all times, has been the evidence and the result of the pleasure that man takes in his work; and also, in later times, of the pleasure he takes in the works of the Great Designer. All artificial foliated ornament, as it is now used, has come, by long process of filtration, from Nature; and, in using Artificial-foliage, the student should refer back to Nature, and continually keep in touch with her inexhaustible wealth of ideas. So will he re-endow the artificial work with a fresh lease of Natural life and vigour, from age to age.

The GRAMMAR will be deduced from observation of Nature. Every man who thinks about it, makes his own version of Artificial-foliage; and the writer gives his version in what follows; but there is no particular virtue in it, except as the experience of one student which he offers to others. It may be useful to others as a Grammar, *i.e.* as shewing such little of the infinite Beauty of Nature as the writer has been able to assimilate and reduce to rule, *i.e.* his own deduced or invented Rule; but he would leave to others, and indeed require of each that he or she should dig for himself in the field of Nature, and make his own Rules. All that the writer pleads for in this is—that there should be a Grammar of some kind.

§ 5.—THE PARTS OF FOLIAGE.

The DIFFERENT PORTIONS of Natural-foliage, which are utilised by the Artist in designing his Artificial-foliage, will be treated-of in the following order:—

- (1) The Stem, primary, or Trunk,
- (2) „ „ , secondary, or Branch,
- (3) The Leaf, and its edge,
- (4) The Clothing of the Stem, or Sheath-leaf,
- (5) The Stem-calyx,
- (6) The Flower,
- (7) The Elongated-flower-growth,
- (8) The Leaf-cup,
- (9) The Endings, and
- (10) The Vermiculate-tendrils.

In each Chapter: an attempt will be made to deduce Principles from Natural-foliage; and they will be afterwards applied to the design of that which is Artificial.

CHAPTER II.—THE STEM.

§ 6.—PRINCIPLES FROM NATURE.

GROWTH from ONE ROOT is the usual law of Plants. There are Exceptions, in the case of "Creeping Roots" or "Runners"; but the Ornamentist selects the familiar examples of ordinary growth rather than the exceptions (see § 20 of "Natural Foliage"). A number of Plants may be placed-together in one Bed, for the purpose of producing a Mass of colour; as a number of Colonists may be "planted" in one locality, for mutual defence; but each Plant is complete in itself, with a single Root or Start.

GROWTH in ONE DIRECTION is another law. Every plant commences to add the new growth longitudinally, at the end of the stem which was formed in the preceding year; and the growth of the Foliage, when it parts from the parent stems, follows the same law—always *onward* from the Root, never backward.

UPWARD GROWTH, away from the surface of the Earth, to seek Air and Sunshine at the least expenditure of material, is another law. There are Exceptions to this in those Trees whose Branches are called "weeping"; but, in these instances, the direction of the Stem is upwards; and so also is that of the Branches at their commencement. Certain Flowers, *e.g.* the Harebell, are pendulous; and most fruit hangs downwards; these are, however, instances, not of the Growth of the plant but, of the effect of Gravitation on a small portion of it.

DECREASE in GIRTH, is another law in Exogeneous plants. The Stem adds, in each year, a new ring of wood outside the existing ones; and, as the stem grows in length each year, it follows that the Tree will be conical; as is well shewn in the Diagram by Mr. H. Coltas, in Chap. IV. of "What may be learned from a Tree", New York, 1860, whence fig. 2 is borrowed. The numerals '53 on the stem, shew where the cone ended (*i.e.* where the tree ended) in the year 1853, as is shewn by the thin lines converging. The numerals '54 on the stem shew the year's growth in length, from '53; and the converging lines which meet at that point, if followed downwards, will shew the increase of girth. The remaining dates on the stem, '55 to 1858, shew the succeeding conical layers; and the same holds good with reference to the branches.

RESTRAINT OF CURVATURE is a pervading law of all the most beautiful curves in Nature.

If the student will apply a Straight-edge as a Chord to the subtle lines of the human body: he will observe how small is the Versed-sine, *i.e.* how reticent the curvature. He will also observe how, in noble Trees, the Trunk, after throwing-out a branch towards the *E.*, will grow in a very slight curve towards the *W.* before it resumes the vertical, for the purpose of preserving the equilibrium of the Tree (fig. 6E); in the same manner as the Labourer

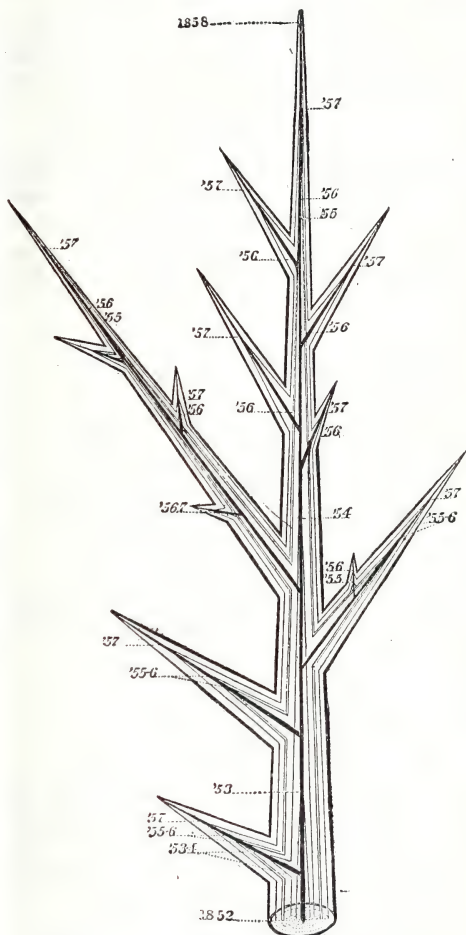


FIG. 2.

with the heavy bucket in his right hand leans-over with his body towards the left. The Stems of Shrubs, on which the leaves grow in the alternate arrangement, are also bent very slightly aside (fig. 6B), for a similar reason. From these two examples it will be seen that the Growth-curvature of the Trunk or Stem exists, on *occasion*, only when there is a Reason; and, in *amount*, only so much as is necessary for the Stability of the Tree. See § 15.

RADIATION in CURVATURE is a result either of Gravitation and Wind-stress acting on the thinner ends of Stems, as is shewn in the Palm Tree, whose leaves are an illustration of this kind of Radiation, which is therefrom termed *Palmate Radiation* (see fig. 3B); or of Individualism, as is shown in a group of Rushes which spread-out at the top, as if each stem were diverging from its neighbours to seek its own share of air and sunshine. See § 16.

The STEM-SURFACE suggests various treatments to the student; being smooth, corrugated, jointed, scaled, twisted, &c. See § 17.

§ 7.—GROWTH-LINES.

GROWTH-LINES are the imaginary lines which pass along the centre of every stem, branch, leaf, and flower; and, by their direction, and dimension, shew the curvature, and size, of the Plant or the Ornament. They

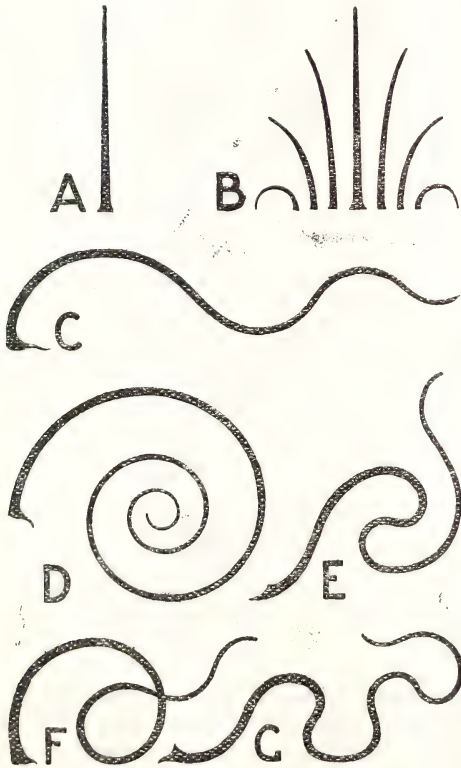


FIG. 3.

have an important influence in the Decorative-application of Foliage, especially of Artificial Foliage. The Artist commences the drawing of any piece of the latter, by setting-out the Growth-lines in the intended position, direc-

tion, and size; and then proceeds to clothe and enrich them. They are thus disguised, but not obliterated; and they should always be traceable in Ornament.

Natural-foliage grows in curves, which are so subtle in amount of curvature, and so complicate in arrangement, that it is impossible to classify their infinite variety of beauty.

Artificial-foliage is drawn in curves which, on the contrary, are chiefly geometrical; and can be classified as follows:—

The larger Stems are:—

- (a.) Straight (fig. 3A), see § 8,
- (b.) Palmate (fig. 3B), see § 9,
- (c.) Undulate (fig. 3C), see § 10, and
- (d.) Spiral (fig. 3D), see § 11.

The smaller Stems, and Branches, are:—

- (e.) Folded (fig. 3E), see § 12, and
- (f.) Looped (fig. 3F), see § 13.

The Tendrils are:—

- (g.) Vermiculate (fig. 3G), see § 14.

(The Diagrams A to G of fig. 3, as representing *geometrical lines*, should more correctly have been *uniform* in width, and that should have been as *narrow* as possible; but by being broad at one end, as if torn from a Tree-trunk, and being tapered to thinness at the other end, as if of conical growth (see § 6), the student will be impressed with the analogy to Natural-foliage. This tapering of the Growth-line will be adhered-to in the figs. which illustrate this Chapter.)

§ 8.—THE STRAIGHT GROWTH-LINE.

The STRAIGHT GROWTH-LINE is used:—

- (1) in a Panel or Free-ornament, when it is symmetrically treated with a centre stem (fig. 10C);
- (2) in a Border, when it is Vertebrate (fig. 52);
- (3) in a Frieze or Moulding, when it is treated with Transverse ornament (figs. 5, and 53); and
- (4) often in Diapers. See also Meyer, "Handbook of Ornament," plates 93, 101, 131, 177.

§ 9.—THE PALMATE GROWTH-LINE.

The PALMATE GROWTH-LINES are used:—

- (1) in a Panel, sparingly;
- (2) in a Free-ornament, Border, or Frieze, often (fig. 5); and
- (3) in Diapers occasionally. See also Meyer, plates 103 to 107.

§ 10.—THE UNDULATE GROWTH-LINE.

The UNDULATE GROWTH-LINE is most used:—

- (1) in a Border (figs. 7E, 8A, 9A, 37 to 39, 50, 51);
- (2) in Diapers;
- (3) it is inappropriate in a Panel (fig. 47); and also in a Frieze (fig. 49). See also Meyer, plates 94 to 96.

§ 11.—THE SPIRAL GROWTH-LINE.

The SPIRAL GROWTH-LINE is used in every application of ornament except Mouldings. It is appropriate for the curvature of a Stem which is diminished in thickness. The gradual decrease in thickness will give a gradual increase in flexibility; and, assuming that the bending influence is equal and applied in one direction, the thinner end would be bent in a curve of smaller radius than the thicker end. Hence with a continued application of the bending influence the result will be a plane Spiral. The beautiful curve made by the Proboscis of the Butterfly or Moth, is an example of this.

Plane Spirals are divided into two classes:—

- (1) the Arithmetical (or Equal-distance) Volute or Spiral, the distance between the successive rolls of which is *constant*, and the increase of which results from adding; and
- (2) the Geometrical (or Equi-angular Volute) the distance of which increases *in an increasing ratio*, and the increase of which results from multiplying.

An ARITHMETICAL SPIRAL (invented by Archimedes of Syracuse, fl. 250 B.C.) is shewn in fig. 4A. In this spiral: the first revolution, commencing from the centre, is fairly pleasing; but the succeeding ones have a dull effect. It is not in accordance with Nature; and is not suitable for the Artificial growth which is deduced from Nature.

A GEOMETRICAL SPIRAL is shewn in fig. 4B. All portions of this curve appear to be full of Life. It is found frequently in Nature, *e.g.* the shells of the Volutidæ family of Mollusks. The diagram was described by the Instrument invented by Mr. F. C. Penrose, P.R.I.B.A., the well-known Architect, Greek-scholar, and Mathematician; and the beauty of the curve will be seen by all.

An ELLIPSOIDAL-SPIRAL, as shewn in fig. 4C, has also been used in Decoration. It was mostly used by a M. Salembier; as the Growth-line of Ornament, and for Volutes in

Consoles, &c. It can be described by the Curve-machine of Mr. R. Inwards, P.R.M.S., F.R.A.S., &c. There is an analogy in mass-

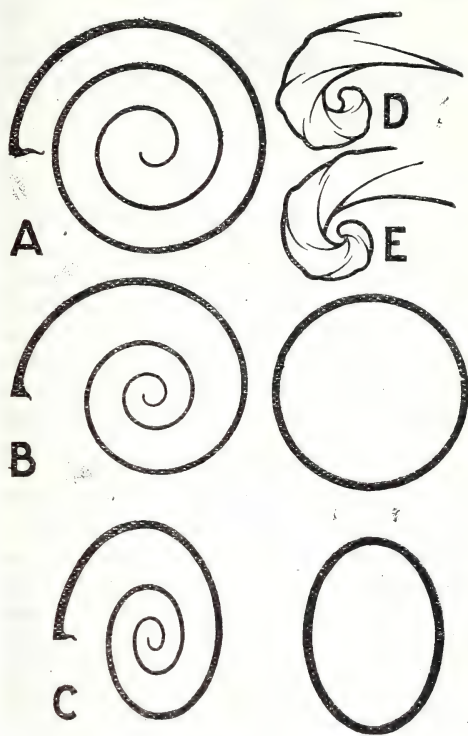


FIG. 4.

shape between fig. 4B and the adjacent Circle, as also between fig. 4C and the adjacent Ellipse; hence the terms:—Cycloidal-spiral, and Ellipsoidal-spiral.

§ 12.—THE FOLDED GROWTH-LINE.

The FOLDED GROWTH-LINE may be used similarly to the Spiral Growth-line. It enables a little more Play-of-line to be introduced; and it facilitates good Curves in difficult Panel-shapes. The idea was probably derived from the Evolute-spiral Band (see Meyer, plate 97), or from Vermiculate-tendrils. The Sketch in fig. 5 (p. 886) shews Folds of the stem at the smaller groups. This, and the following Treatments, can only be applied to small stems, analogous to the small stems in Nature: they are not found in the larger stems and trunks; and are not suitable to the main-stems of important ornament.

§ 13.—THE LOOPED GROWTH-LINE.

The LOOPED GROWTH-LINE is of similar use, derivation, and application, to the last. The Sketch in fig. 5 shews Loops of the stem in the centre group.



FIG. 5.

§ 14.—THE VERMICULATE GROWTH-LINE.

THE VERMICULATE GROWTH-LINE is used only in Panels, Friezes, and Diapers, where the Interstices between the more important portions need some filling-up or Texture imparted to them, to avoid the bare spaces which might otherwise become conspicuous and destroy the breadth-of-effect (see fig. 49).

§ 15.—RESTRAINT OF CURVATURE.

RESTRAINT OF CURVATURE should be felt in all Artificial-foliage; but more especially in that which is applied to functional features, *e.g.* Supports, Framing, and Construction generally. If the student be in doubt: then it is better, as in the case of Richness and Complexity, to lean towards the side of Plainness, Simplicity, and Restraint. The Direction-of-curvature in a large Stem may be changed each time it throws-out Leaves or Branches, *i.e.* at each Node, as is shewn in fig. 8A. There might be *two* directions-of-curvature between the Nodes, as will be shewn later; but *three* changes of direction would give a weak hesitating character. This does not apply to Tendrils, which will generally be vermiculate.

§ 16.—RADIATION IN CURVATURE.

RADIATION IN CURVATURE is one of the most beautiful effects in Ornament. Palmate-radiation appears to have been felt as far back as the Egyptian times; and it has been used in every succeeding epoch, fig. 29 (see also Meyer, plates 101 to 107). It is also seen in the Venation of the Korinthian leaf, as shewn in figs. 13, 25 to 27, 31, 54 to 60, &c. Another kind, termed Branching-radiation, is shewn in fig. 41A, in which the lines d, e, and f, as well as the Main-stem b, and the Spiral-branch, all radiate from the Node a.

§ 17.—THE STEM-SURFACE.

THE STEM-SURFACE may be either plain in the smaller ones, or enriched in the larger ones. The Ancients often treated shafts:

with Channellings, as in Meyer, plates 122, 136, &c.; with Leaves, *ibid*, plate 121, figs. 4 and 6; or with Diapers of leaves, *ibid*, plates 136, 137, &c. They appear to have derived suggestions from the Corrugation of the bark, in the Channellings of the ornament on the Ionic Pilaster-capital of fig. 29 *seq.*; with a further improvement in the Twisting of the stem on the Stele-crest in same fig.

THE TWISTING OF THE STEM, and the spiral arrangement in phyllotaxis, are very characteristic of some strong plants in Nature; and twisting the stem is useful in Artificial-foliage. The lines of the twist may grow upward in either direction; and they will either: improve the curvature by giving it a strong, living, character as in the last example, and in fig. 4E in which the lines of the twist appear to radiate from the centre of the spiral; or give the curve a dull effect by growing in the other direction, as in fig. 4D.

CHAPTER III.—THE BRANCH.

§ 18.—PRINCIPLES FROM NATURE.

THE NODE is that place on the stem from which the leaves or branches issue. It is treated as follows:—

- (a) With no perceptible exterior alteration in the stem;
- (b) With strongly-marked articulation, as in the Bamboo; and
- (c) With a Whorl-of-leaves to emphasize the articulation. See § 19.

THE NODAL-DISTANCE is the length of the Internode or space, measured along the stem, from one node to the next. Plants differ very much in this; but it may be stated generally, of those plants which are most suggestive, that, after the plant has arrived at maturity, these distances decrease gradually each year; so that—in proportion to the Distance-from-the-Root and the Decrease-in-Girth—the Nodal-distance diminishes. See § 20.

THE NUMBER OF LEAVES at each Node, or of Branches, in Nature, follows various geometrical arrangements which have been clearly

shewn by Dr. Dresser in chap. vi. of his interesting and suggestive book—"The Art of Decorative Design", 1862. In the decorative treatment of Natural-foliage: the arrangement proper to each Plant must be strictly followed; but in Artificial-foliage the number of practicable arrangements is reduced to three:—

- (a) The Opposite arrangement (fig. 6A), see § 21;
- (b) The Alternate arrangement (fig. 6B), see § 22; and
- (c) The Verticillate arrangement (fig. 6C), see § 23.

The AXILLARY ANGLE, or Angle which the branch at its commencement makes with the stem, is classified as follows:—

- (a) Brachiate (*arm-like*), when the branch diverges at or nearly a Right-angle (fig. 6D);
- (b) Acute, when the divergence is much less (fig. 6E); and
- (c) Tangential, when the divergence is less than 10° (fig. 6F), see § 24.

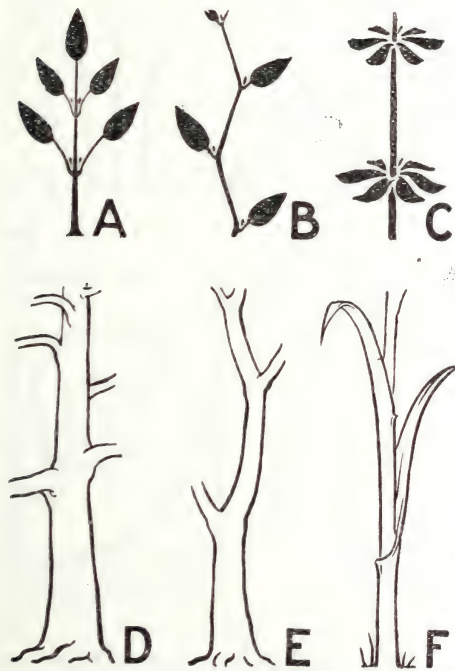


FIG. 6.

The first two of these belong generally to Exogeneous plants; and the third to Endogeneous plants.

DIMINUTION IN SIZE, from the Bole to the Twig, is a general law of Nature. It is shewn in four manners:—

- (a) The Stem diminishes as it throws-out each Branch, not only by reason of the Conical growth mentioned in § 6, but also as if its initial energy were lessened by parting with some of its substance;
- (b) Each Branch is less than the parent stem;
- (c) Each successive Branch is less than its elder or preceeding sister Branch; and so on, to the little baby shoot of last year; and
- (d) The Leaves, &c., are less on the smaller (younger) branches than on the larger (older) ones.

§ 19.—THE NODE.

The NODE is often adapted in Artificial-foliage:—

- (a) Without emphasis, in figs. 1, 48A, 43B;
- (b) Articulated, in fig. 29; and
- (c) Emphasized by a Whorl-of-leaves or Stem-calyx, in figs. 48B, 43A, and 47.

All of these treatments are seen in fig. 49 (the "Trajan Frieze"), in which the Vermiculate-tendrill shews the first, the Branches (mostly) the second, and the Stem shews the third method.

§ 20.—THE NODAL DISTANCE.

The NODAL-DISTANCE in Artificial-foliage may be modified in four varieties:—

- (a) All similar, and equal, with no diminution of the Stem (fig. 7A);
- (b) All similar, but diminishing proportionately to the diminution of the Stem (fig. 7B);
- (c) Alternate arrangement of long and short distances, and equal repeats, with no diminution of the Stem (fig. 7C); and
- (d) Alternate arrangement, as in fig. 7C, but diminishing, as in fig. 7B. (fig. 7D).

When the foliage is low-class, and it is applied in a Band: then the Stem and its Nodal-distances may be continuous, as in figs. 7A, and 7C.

When the foliage is higher-class, and it is applied in a Panel or Frieze: then the Stem and its Nodal-distances should be diminished, as in figs. 7B, and 7D.

The Undulate-stem, which is not diminished but is continuous, may be likened to the Ecliptic-line on the development of a Globe.

Then the two lines enclosing the Border (fig. 7E) might be likened to the Tropics: the points marked d d on the Stem, at which it approaches nearest to the Tropic-lines, may be termed Tropic-points; and the points marked a a on the Stem, at which the direction-of-curvature changes as the Ecliptic crosses the Equator, may be termed Equatorial-points.

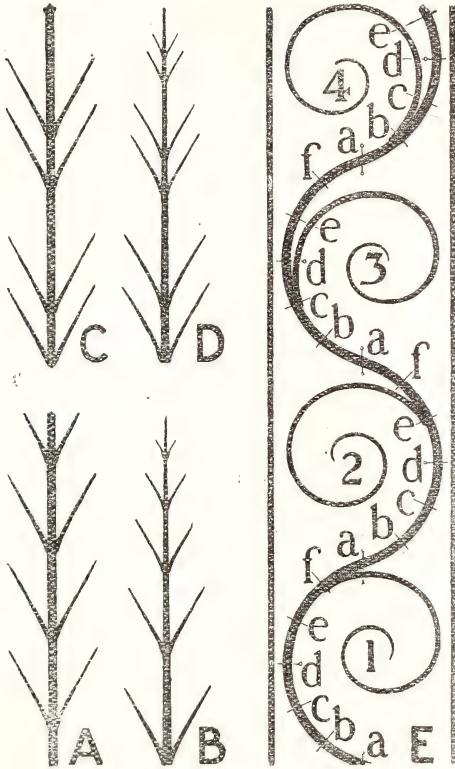


FIG. 7.

THE POSITION OF THE NODE, in relation to the Equatorial-points a a, may vary. To illustrate this: the distance from one Equatorial-point to the next (a to a) is divided into six equal parts, as marked by the letters a to f (repeated) in fig. 7E; and the Spiral-branches in that fig. and in fig. 9A are numbered successively 1 to 7. Branch No. 1 starts from f (it could not start from the point a above it, as that point belongs to the Stem-curve above): hence this branch is the highest in position on the Stem, and also the shortest in length. No. 2 starts from a position lower down at e, and is longer. It is not well to have a Branch starting from its Tropic-point d, so No. 3 starts from c. No. 4 starts from b. No. 5 starts from its proper Equatorial-point a. No.

6 starts still lower from the point f in the Stem-curve below; and is still longer. No. 7 starts from the point e of the lower curve, which is the lowest position for the Node that is consistent with clearness; and it is the longest branch. The last two are much richer in effect; but sometimes with a loss of Clearness. In the "Trajan Frieze" (fig. 49), and the "Medici Pilaster" (fig. 47): the Branches start still lower, from the point d below.

The student will not copy the two figs. 7E, and 9A, in one Band, making each of the seven Branches to start in a different position. He must determine which of these seven positions will best suit his scheme; and then arrange *all* his Branches in that one position.

§ 21.—THE OPPOSITE-ARRANGEMENT.

THE OPPOSITE-ARRANGEMENT of Branches is most suitable when Rigidity is required, as in the Panel on a Pilaster-shaft (see Meyer, plate 131 except figs. 4 and 5). It may be

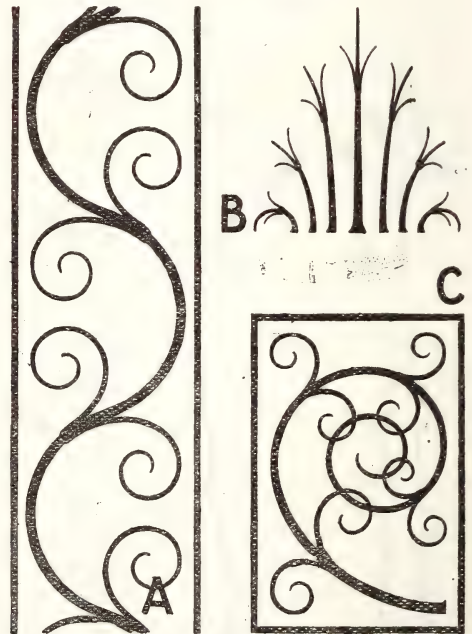


FIG. 8.

used with either straight or curved Stem, as shewn in figs. 7A to D, 8A to C, 10C, &c.; but is generally associated with Symmetry and the severer treatments. It is fuller and richer than the Alternate-arrangement.

§ 22.—THE ALTERNATE-ARRANGEMENT.

THE ALTERNATE-ARRANGEMENT is most suitable when some Liberty is allowed, as in

Panels and other non-functional features. It is used with curved Stems, as shewn in 9A, and 9C; and is generally associated with Balance and the freer treatments. It does not accord with Growth-lines which are sym-

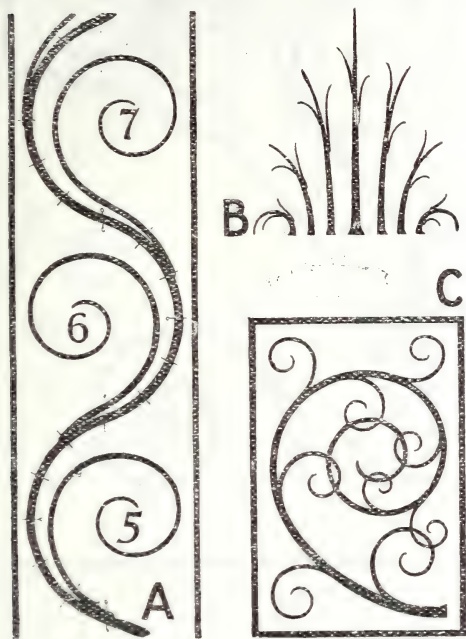


FIG. 9.

metrical, as shewn in fig. 9B. It is peculiarly suitable to the Undulate-stem, as the Undulation (see § 6) is suggested by the change in Direction-of-growth necessary to preserve the equilibrium of the Natural plant.

§ 23.—THE VERTICILLATE-ARRANGEMENT.

The VERTICILLATE-ARRANGEMENT is most suitable for features in independent or complete relief, *e.g.* Finials, Candelabra, &c. (see Meyer, plates 111, 121, 135, 136). It is also seen in the Corinthian capital. It is not easy to adapt the "all-round" arrangement to a plane; and hence this is not clear in flat presentment.

§ 24.—TANGENTIAL-BRANCHING.

The BRANCHING, in Artificial-foliage, has nearly always followed the Tangential-arrangement. In this: the Leaves and Branches part from the Stem with very slight divergence, like the "Points" of a Railway-junction. The eye is then able to run along both curves without the sudden change or stop which is so irritating. When the Growth-line of the Branch follows that of the Stem for a short

distance before it changes its direction, as in Branch No. 7 on fig. 9A, a sense of unity is given to it which suggests that both are parts of the same whole.

There have been exceptions to this law of Tangential-branching; but the student may label them, and pass them over. Of the two kinds of branching:—Angular and Tangential—the Angular is appropriate in Natural-

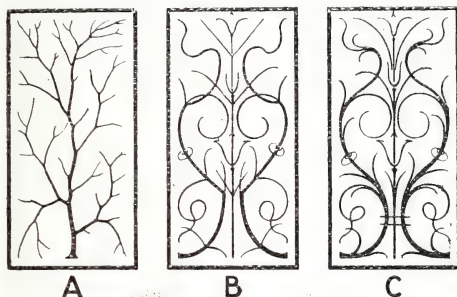


FIG. 10.

foliage, as shewn in fig. 10A; and the Tangential is appropriate in Artificial-foliage, as shewn in fig. 10C. Any attempt to mix Spiral-curves with Angular-branching, as shewn in fig. 10B, can only result in an incongruous abortion; and though, like the remark of a precocious child, it may be considered "quaint", yet the repetition of the trick soon produces disgust.

§ 25.—EXHAUSTION.

The DIMINUTION, in the lengths, may be illustrated in the fig. 11A, in which all the lines are divided into equal units of length. The Nodes 1', 2', 3', &c., are placed at the points b of fig. 7E; and the Nodal-distances, &c., may be seen to diminish if the number of units in each be counted, as is shewn in the following:—

TABLE OF LENGTHS IN UNITS.¹

	Nodal-distance. 1' to 2', &c.	Spiral-branch.	Outer Sheath a, b, c, &c.	Inner Sheath.
Branch 1	... 8 ...	16 ...	a .. 8 ..	5
" 2	... 7 ...	14 ...	b .. 7 ..	4
" 3	... 6 ...	12 ...	c .. 6 ..	3
" 4	... 5 ...	10 ...	d .. 5 ..	2

Similarly: the length of the ornament, measured along the Equatorial-line, will be diminished. Thus the length of the Stem

which encloses Branch No. 1 is 6 units—for No. 2 is $5\frac{1}{2}$ units—for No. 3 is $4\frac{1}{2}$ units—and for No. 4 is 4 units—as shewn along the straight-line fig. 11C.

It is a good method for the student to draw the foliage when straightened-out along straight Growth-lines, as shewn in fig. 11B (this diagram had to be bent at the bottom, for the purpose of economising space; and it stops short at 4' the Node of Branch No. 4, for same reason). This method, which is analogous to turning Poetry into Prose, will shew if the foliage be consistent throughout.

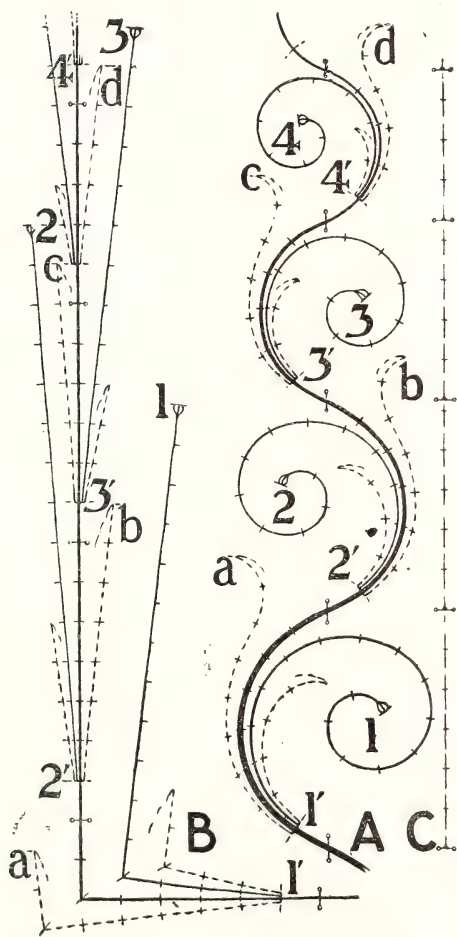


FIG. 11.

It must not be supposed that the student can design foliage by this Arithmetical method. It will not supply the place of Invention; and is only given as a possible means of Testing, by measurement, that which the ornamentist does "by his eye". There is no particular virtue in the numbers that are used;

but they will serve to remind him that there should be *some* Method and Scale of diminution.



FIG. 12.

It will be seen from the above Table, and § 11, and clause c of § 18, that the younger Branches, being smaller in girth, will bend in curves of smaller radius than the older ones. This diminution in Radius-of-curvature is shewn in fig. 11A; and also in 9C, and 12B. In fig. 12A the spirals are all of about equal size, which is contrary to what is stated above, and not so pleasing in effect as is fig. 12B.

Another mistake, in exhaustion, is shewn in fig 12C, in which the Branch b parts from the Stem at c in a curve of greater radius than the Stem a, as if it were of larger girth than its parent Stem, which is contrary to Nature. This mistake is corrected in fig. 12D, in which the Stem fd is larger in girth and also in Radius-of-Curvature than the Branch e which springs from f.

Miscellaneous.

THE SCIENTIFIC APPLICATIONS OF PHOTOGRAPHY.*

It is not so very long since photography occupied a very subordinate position in the world alike of science and of art. Scientific men looked on photography as a mere art, artists regarded it as a mere science.

And to a large extent the reproach was well deserved. Though the list of the earliest workers in photography contains many illustrious names, yet it is true that a large proportion of the most important contributions to photographic knowledge were not made by scientific workers, or by men who worked in scientific methods. They were obtained by practical men, seeking for results, often indeed seeking for them successfully by methods which could not have commended themselves to men better equipped with scientific knowledge. Of course this was the consequence of the fact that photographic science was early associated with photographic practice, and the same remark holds good of other sciences, electricity for instance, in which theory and application to practical use advance with equal steps; but I think it applies more to photography than to any other.

At the present time, we have indeed reached a very different condition of things. All the most striking of the recent advances in the science are the result of elaborate scientific research. The most recent improvements in lenses were the fruit of long and laborious investigation into the optical properties and the chemical nature of certain sorts of glass. The increased speed of modern plates, and their improved power of rendering colour values more truly, have only been obtained by minute knowledge of the condition of the problem to be solved, and by careful application of the most recent results of chemical and physical research. If the old photographic crux, the reproduction of colour, has been solved, or, at all events, if a possible method has

been indicated for its solution, it was not by haphazard experiment, but by careful adjustment of means to secure an anticipated result. Nowadays, we can only hope for improvement by utilising the advance of scientific knowledge.

But if the present position of photography is due to progress in the kindred sciences, how amply has she repaid the debt! There is not a single branch of science in which photography is not largely used. There are many whose progress is now absolutely dependent on the power of the camera to observe more accurately, more independently, more minutely, more rapidly, more permanently, than the human eye. If, as appears to be the case, we have reached the limits of human vision, aided by the most delicate instruments that can be constructed, it is difficult to imagine what limits need be set to photographic vision, can we but construct instruments of accuracy sufficient to allow its full powers to be utilised.

I imagine that the first application of photography to a scientific purpose must have been when Dr. Draper in New York photographed the moon. Whether the pictures he obtained were of any astronomical value, I do not know; certainly those taken a little later, in 1852, by Dr. Warren de la Rue, were, and they were the precursors of the long series of astronomical photographs, culminating in Dr. Common's nebula of Orion, and in the great work of charting the heavens by photography which is now in progress.

The advantages of the "retina which never forgets," and it might be added which never tires, which accumulates weak impressions and stores them up till they become one strong one, were long since recognised by De la Rue, and I suppose it will not be very long before, for astronomical purposes, eye observations are entirely superseded by photographic. The photographic camera is now an indispensable adjunct to every large telescope, if indeed it would not be equally correct to say that the telescope is an adjunct to the camera, since the astronomical telescope tends more and more to assimilate to the form adopted long since by Mr. Rutherford, in which the visual rays are of but slight importance, and the chief attention is given to the accurate utilisation of the more chemically active rays at the violet end of the spectrum.

In his recent address to the Photographic Convention at Dublin, Sir Howard Grubb, than whom nobody is better qualified to speak on the subject, dwelt on the services which photography has rendered to astronomy, and gave several striking illustrations of those services. Indeed, if one not qualified to speak on such matters with any authority might hazard an opinion, it would almost seem as if the power of recording observations had already outstripped the capacity for examining the observations, and drawing conclusions from them. When we are told that a photographic plate has recorded 10,000 stars in an area not containing a single visible star,

* Extracted from the address of the President (Sir Henry Truman Wood) to the Royal Photographic Society, 9th October, 1894.

one may be excused an expression of wonder as to how the human mind is ever to grapple with problems of such infinite complexity, to turn to useful account observations dealing with such enormous multitudes.

But if the telescope has lately become one of the most important of photographic appliances, the spectroscope may be said to have held that position almost since its introduction. Professor Norman Lockyer, in his well-known text-book, attributes to Sir John Herschel the first suggestion of spectrum photography, and we find that in 1839 he pointed out that the way to investigate sensitiveness was to photograph the spectrum. In the following year he read a paper describing his results of spectrum photography. A little later, in 1842, Becquerel and Draper were both at work photographing the solar spectrum. Twenty years later (in 1864), Miller was turning to practical account the power of photography to record the parts of the spectrum beyond the limits of human vision, and from that date nearly all spectroscopic work has been photographic work. Whether applied to astronomical observation or chemical research, the spectroscope has always been combined with the camera, and it is by the combination of the two instruments that such wonderful results have been attained; and as photographic methods have improved, so have fresh facilities been afforded to the spectroscopic worker.

As an automatic recorder of scientific observations, photography seems to have been utilised in the Royal Observatory about 1847.

The principle thus first applied at Greenwich has received numerous other applications, and, indeed, it is now a matter of course that photographic methods should be used to register the movements of any instrument of whose indications it is desired to preserve a record. Instances are of course numerous in which no other method is possible. Hardly any but a photographic method could register the movements of the light spot of a reflecting galvanometer and thus enable the physicist who, like Langley, is measuring the heat radiated from celestial bodies, to record the minutest differences of temperature, the chemist; like Dewar, who is producing hardly imaginable cold, to record temperatures approaching absolute zero; the metallurgist, like Roberts-Austen, who is dealing with the melting points of metals, to register by a photographically traced curve variations in high temperatures which, but a short time ago, could not be accurately measured at all.

It seems hardly worth while to trouble you with the details of many of the other services which photography has rendered to science, and if I were to attempt an exhaustive list, there are many present to-night who could supplement it out of their own knowledge. The meteorologist has been enabled by its aid to study the form and nature of clouds, the shape and character of the lightning flash. The zoologist has been taught much about animal motion.

The microscopist has long learnt to rely on the camera as the only accurate means of reproducing the objects of his studies. The physicist has by photographic methods investigated many phenomena in which the changes are too rapid for the human eye to follow them. By such means Lord Rayleigh and Professor Boys have obtained long series of pictures of occurrences which all took place within a fraction of a second, thus almost analysing time as the chemist analyses matter.

The uses of photography in ethnology, geology, geography, natural history, archaeology, are too obvious to need mention. They, and many other applications, may be summed up in the remark, that whenever the observer of natural phenomena requires to make an accurate record of his observations, photography supplies the means. It also supplies the means of showing to a roomful of spectators what could otherwise be seen by but a single observer at one time, and has thus rendered to the popularisation of science no less a service than it has led to its advancement.

General Notes.

AGAVE AMERICANA.—The *Agave* is used as an edible in Mexico, and Mr. Carnegie, of Oudh, recommended it for use in India in time of famine. Experiments were made at the request of the Government of the North-West Provinces and Oudh, but the report of these was not satisfactory:—"The result of the experiments made here was to show that no important addition to the foodstuffs of the people in times of famine would be furnished by this plant. The difficulty in dealing with it is to get rid of the very disagreeable flavour that both the cabbage and the flower stalk have in this country."

EUROPEAN RESIDENTS IN CHINA.—The *Monde Economique* says that at the end of the year 1893, 580 foreign commercial firms were established in the open ports of China; the number of foreign residents connected with them reached 9,891. These totals represent a slight increase over those for the year 1891, although they are almost identical with those for 1892. The following are the details, the figures representing the residents being given in brackets. English, 354 firms (4,163); Germans, 81 firms (777); Americans, 30 firms (1,336); Japanese, 42 firms (1,087); French, 33 firms (786); Russian, 12 firms (118); Portuguese, 7 firms (410); Austrians, 4 firms (76); Spanish, 4 firms (357); Dutch, 1 firm (52); Danish, 4 firms (127); Swedish and Norwegian, 2 firms (328); Italian, 4 firms (189); Belgian, 1 firm (50); others, 1 firm (104). Total, 580 firms and 9,891 residents.

Journal of the Society of Arts.

No. 2, 187. VOL. XLII.

FRIDAY, OCTOBER 19, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Proceedings of the Society.

CANTOR LECTURES.

ARTIFICIAL FOLIAGE IN ARCHITECTURE.

BY HUGH STANNUS, F.R.I.B.A.

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Lecture II.—Delivered February 19, 1894.

CHAPTER IV.—THE LEAF.

§ 26.—DEFINITIONS.

The LEAF - ARTICULATION, or Junction with the Stem, follows two methods; and the leaves are thence termed :—

- (a) Petiole - leaves, *i.e.* those with a Petiole or stalk, *e.g.* the Lime, Plane, Oak, &c., in Nature; and fig. 48 c; and
- (b) Sessile - leaves, *i.e.* those without stalk, *e.g.* the Grass, Corn, &c., in Nature; and figs. 37 to 39, 47, 49, &c.

The LEAF - SHAPE, generally, by its treatment determines the name. It may be :—

- (c) Simple, *i.e.* not cut-up into distinct pieces, *e.g.* the Lime, &c., in Nature; and figs. 13A, 13C, &c.; and
- (d) Lobate, *i.e.* divided in lobes, *e.g.* the Plane, the Maple, &c., in Nature; and figs. 13B, 13D, &c.

The LEAF - EDGE, also, determines the name. This may be :—

- (e) Entire, *i.e.* with no modification of the edge;
- (f) Sinuate, *i.e.* with an undulating line for the edge;
- (g) Serrate, *i.e.* with toothings which are small and regular, like those of a Saw; and
- (h) Bi-serrate, *i.e.* when the Serratures are themselves treated with smaller serratures.

The COMBINATION of the above TERMS is used to name any Artificial-leaf; thus :—

- (z) Petiole-simple-biserrate—most of the leaves in fig. 28; also those in fig. 48;
- (k) Sessile-simple-sinuate—is a “Water-leaf”, *g.v.*;
- (l) Sessile-simple-serrate—fig. 13A;
- (m) Sessile-simple-biserrate—fig. 13C;
- (n) Sessile-lobate-serrate—fig. 13B; and
- (o) Sessile-lobate-biserrate—fig. 13D.

All of these varieties are used; but chiefly the last one. The great majority of Artificial-leaves are *sessile*; so that term will not be used again; and only those which are exceptional (*i.e.* *petiole*) will be specified as they occur.

The PARTS of the LEAF, which it is necessary to name, are shewn in fig. 14. The Lobes are numbered 1 to 5. The Sub-lobes are lettered A, B (repeated). The Teeth are lettered α , β (repeated).

- a, b, or c, is a Rib (projecting), on the *outer* surface only; of which
- a is the Centre-rib, belonging to the centre-lobe of the Leaf;
- b is a Side-rib, belonging to one of the side-lobes; and
- c is a Secondary-rib, belonging to one of the sub-lobes.
- f, g, or h, is a Vein (grooved), on the *inner* surface only; of which
- f is the Centre-vein, belonging to the centre-lobe;
- g is a Side-vein, belonging to one of the side-lobes; and
- h is a Secondary-vein, belonging to one of the sub-lobes.
- l, or m, is a Sinus (*gulf*), or interstice between adjacent parts of the Leaf; of which
- l is a Primary-sinus, between two adjacent lobes; and
- m is a Secondary-sinus, between two adjacent sub-lobes of the same lobe.

The interstice between two adjacent Teeth of the same sub-lobe, is termed a Siniculus.

- r, or s, is a Pipe (or wrinkle, projecting), on the *inner* surface mostly; of which
- r is a Primary - pipe, connected with a Primary-sinus; and
- s is a Secondary - pipe, connected with a secondary-sinus.
- v is the Seat of the leaf, which is articulated to the Node of the stem.

From the above it will be seen that :—

- (p) The whole LEAF (from the Seat-line,

- vv, to the Leaf-point), is divided into Lobes (marked 1, 2, 3, &c.), of which, in this example, there are five ;
- (g) Each LOBE (from one Primary-sinus to the next one), is divided into Sub-lobes (marked A, B), of which, in this example, there are three in the Centre-lobe, 1; and two in each Side-lobe, 2, 3, &c. ; and
- (r) Each SUB-LOBE (from one Secondary-sinus to another), is divided into Teeth (marked α , β , &c.), of which,

in this example, there are three in each Centre-sub-lobe, A, and two in each Side-sub-lobe, B.

- (s) Each Lobe, or Centre-sub-lobe, is provided with a Primary-rib on the Outer surface, and a Primary-vein on the inner ;
- (t) Each Side-sub-lobe is provided with a Secondary-rib and Secondary-vein ; and
- (u) The other subordinate Teeth have no Rib or Vein.

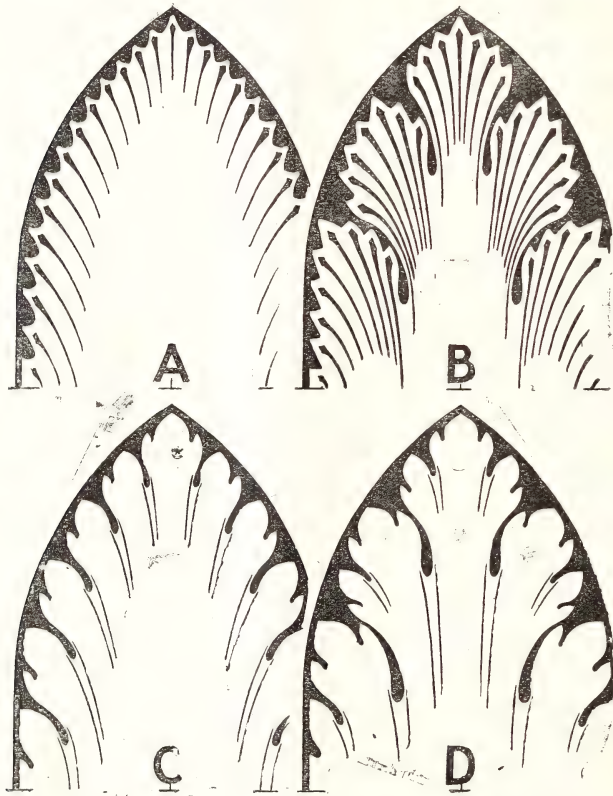


FIG. 13.

- (v) Each Primary-sinus is provided with a Primary-pipe ;
- (w) Each Secondary - sinus is provided with a Secondary-pipe ; and
- (x) A Siniculus has no Pipe.

§ 27.—PRINCIPLES FROM NATURE.

(a) ARTICULATION, or junction of Leaf and Stem, is arranged in two Methods : the Petiole, and the Sessile ; as before-mentioned.

The Petiole-articulation is by means of a Stalk, which joins the Stem at its lower end,

and forms a portion of the Rib-work on the outer-surface of the Leaf at the other. The Petiole appears to act as a "little Foot" for the Lamina, or broad portion, of the leaf ; hence the term. This is the normal method of Exogenous plants, *e.g.* the Lime, Plane, Oak, &c. The length of the Lamina, in proportion to its breadth, varies from equality to twice the breadth.

The Sessile-articulation has no interposed Stalk, but is joined to the Stem at the Node, generally enclosing it, as if it were wrapped-

round. It appears to "sit" upon the Node; hence the term. This is the normal method of Endogeneous plants, *e.g.* the Grass, Corn, &c. The length, in proportion to the breadth, varies from two to five times the breadth. (See § 28.)

(b) The LEAF-SHAPE is, almost universally, pointed at the upper end, which is hence termed the Apex. The exceptions being the Geranium, Nasturtium, Clover, Water-lily, and a few other plants. This is well-contrasted with the shapes of Flower-petals, which are generally

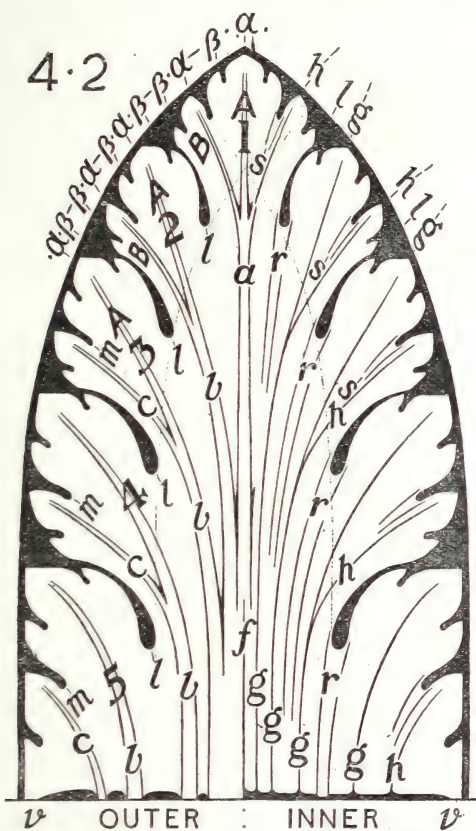


FIG. 14.

Cuneate, Retuse, &c., and thus, when arranged radially, compose a circular Mass-shape, which is a pleasing variety to the acute shape of the Leaf. (See § 29.)

(c) The LEAF-EDGE is, generally, varied and *rich* in Shape, while the leaf is *dull* in Colour. The Petal-edge, on the contrary, is *dull* in Shape, while the petal is varied and *rich* in Colour. This fact, which is an illustration of the law of Compensation, gives great charm in Nature. The various modifications which are used by the ornamentist are given in this section from (z) to (i). The Softened-edge,

which is produced by Sinuation and Serration; and the Variety in the size and shape of the teeth of the latter; are much more pleasing than the hard edge of the Entire leaf.

(d) SINUATION of Leaf-edge is seen in an exaggerated degree in the Oak-leaf. There are however other leaves *e.g.* in Aquatic and other Endogeneous plants, which by redundancy of the Lamina or Leaf-blade, appear to have a sinuate edge; and these latter are taken as the type. (See § 30.)

(e) SERRATION, in the Leaf-edge, is characteristic of many Exogeneous plants. This is one degree of Variety in treatment of the edge; but it is not very interesting. Suggestive examples are found in nearly all Exogeneous plants. (See § 31.)

(f) BI-SERRATION, in the Leaf-edge, is characteristic of the great majority of Exogeneous plants. There are two degrees of Variety in this treatment; and the edge is much more varied and interesting than in the Serration treatment. Beautiful and suggestive examples are found in the Vine, Thorn, Maple, Plane, &c. (See § 32.)

(g) LOBATION, or the division of the Leaf into Lobes, is an interesting and most important branch of this subject. It is traced with deep insight by Mr. Harland Coltas in the pregnant Chapter VII. of his Book already quoted; and the following is adapted from his view. The two forces in Plant-life are:—(a) the Vegetative (growing and increasing), and—(b)—the Reproductive (flowering and seeding). At the Maturity of the plant: the Reproductive force exhausts the Vegetative. Hence: the Leaves, &c., become more and more *simple* as the Flowering-time approaches. He demonstrates this in the series of leaves taken from the Common Blackberry shewn in fig. 15 (taken from plate III. on page—iii—of his book). He has lettered them from—a—the youngest Leaf, nearest to the Flower, to—i—the oldest leaf on that Stem, *i.e.* from above, downwards; but it will be clearer, for the student, to reverse his order and consider them from below, *upwards*:—

i shows the initial stage of the Leaf, with *five* complete and separate leaflets, a result of the strong individualistic tendency of the un-exhausted Vegetative-force of the plant;

h shews a loss of force, causing Arrested-development on the R.H. side, in which only one Leaflet is formed; and the other Leaflet has degenerated into a Lobe on its outer margin.

g shews further loss, with only *three* Leaflets, which are bi-lobate;
f shews the loss of the Bi-lobation in the L. H. Leaflet;

e shews the loss of Bi-lobation in both Leaflets;
d shews the shortening of the Petiole between the Leaflets;

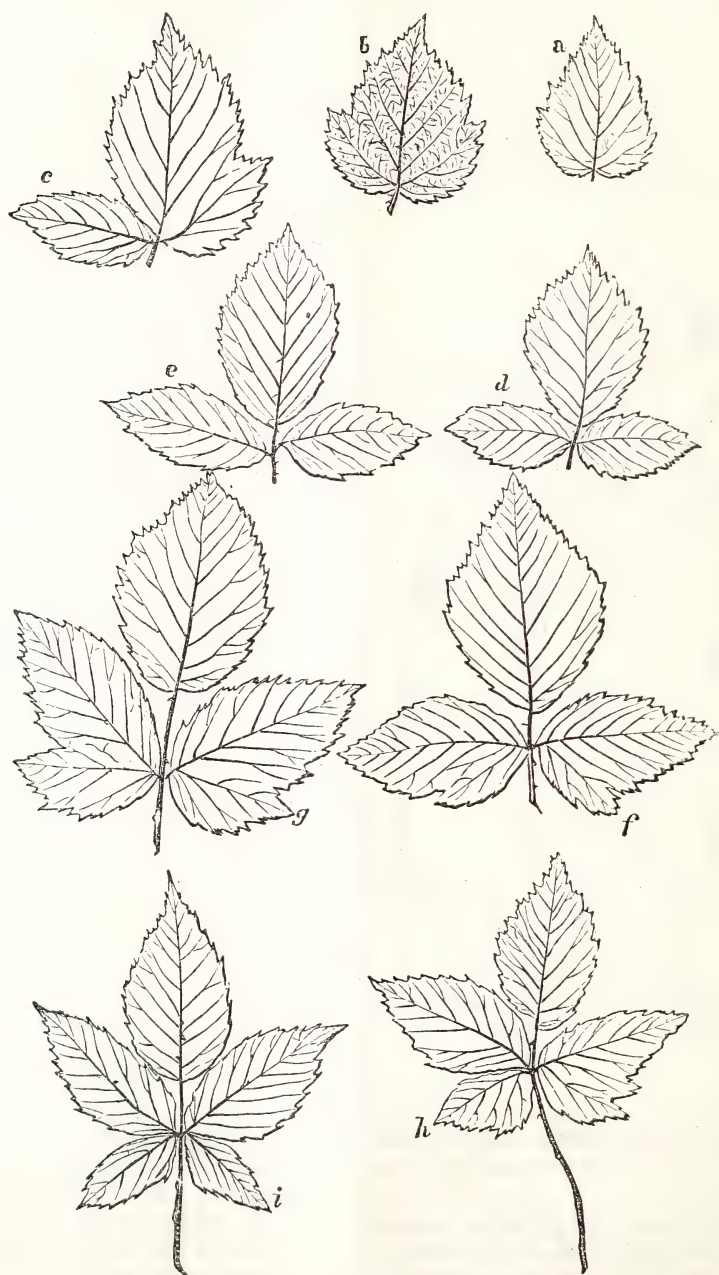


FIG. 15.

c shews the loss of R.H. Leaflet, which has degenerated into a Lobe of the centre Leaflet;
b shews the loss of both Side-leaflets, which

have degenerated into the Side-lobes of the surviving Centre-leaflet; and
a shews the further loss of the Side-lobes, and also the loss of the Petiole.

There is yet the further loss of the Bisserration; and the final degeneration into Sessile-leaves, not shewn in the figure, in those cases in which the energy of the plant is now required for higher service. Beautiful examples of Lobation are seen in the Vine, Mulberry, &c. The Parsley, being bi-pinnate, is too extreme in the amount of sub-division. (See § 33.)

(4) SUBORDINATION is one of the highest qualities of Leaf-shape; and it is a great delight to trace it. It may be shewn in (1) Position, (2) Size, and (3) Shape. Mr. Ruskin, in his "Elements of Drawing", has shewn: that one great object of Composition is to make one Whole out of several things; and that this can be effected in two ways:—

Firstly, by arranging one of them to be more important in Position than the others, and by arranging the others to group with it in subordinate positions. Thus of leaves of three sizes marked—*a*—for the largest and—*c*—for the smallest: the arrangement—*a a*,—or—*b b*,—or—*c c*,—with *two* leaves, both equal, is bad, because there is no Central-leaf. The arrangement of *three* leaves—*a b a*—or—*b c b*—is bad, because though there is a Central-leaf, it is not the largest of the group, *i.e.* the others do not shew Subordination. The arrangement—*b a b*—or—*c b c*—is good because of the Subordination of the Side-leaves to the Central-leaf. And the arrangement of five leaves—*c b a b c*—is better because the Subordination, of *b* and *c* to the Central-leaf, is made more manifest as they retire from it. Hence arises part of the pleasure derived from the Greek Anthemion-ornament, &c. Most compound-leaves, *e.g.* the Strawberry, Celandine, &c., shew this.

Secondly, in a group of three, five, or seven Leaflets, the nearer-half of each Leaflet, *i.e.* the half nearer to the Central-leaflet, is smaller than the farther-half; as if, by its Subordination, or suppression of some of its own dignity, in the immediate presence of the Central-leaflet, it sought to give more importance to it. The Horse-chestnut, &c., shew this.

There is, also, a third kind, in which—while the Central-lobe is symmetrical in shape—the Side-lobes are unsymmetrical.

The MAPLE-LEAF, fig. 16A, is an example of all kinds of Subordination. The First kind is shewn in the central position of the largest Lobe, and the decreasing lengths of the Primary-veins in the others—3 2 1 2 3. The Second kind is shewn in the size of each Lobe. The Central-lobe—1—is furnished

with three Teeth, arranged— $\beta \alpha \beta$ —, *i.e.* a Tooth— α —which is central in position, large in size, and symmetrical in shape; with an attendant Tooth— β —on either side, which is lateral in position, smaller in size, and unsymmetrical in shape (being smaller on the nearer-edge to the Central-tooth, and larger towards the outer world). Each proximate Side-lobe—2—has a Central-tooth— α —; but it suppresses the attendant Side-tooth— β —on the nearer-edge to the Central-lobe, and keeps it only on the edge towards the outer world. Each extreme Side-lobe—3—has a Central-tooth— α —only; with no Side-tooth. The above arrangement may be exhibited in the Formula:—

$$\begin{array}{ccccc} \alpha & \beta & \alpha & \beta & \alpha \\ \underbrace{\hspace{1.5em}} & \underbrace{\hspace{1.5em}} & \underbrace{\hspace{1.5em}} & \underbrace{\hspace{1.5em}} & \underbrace{\hspace{1.5em}} \\ 3 & 2 & 1 & 2 & 3 \end{array}$$

which shews the gradual decrease of the Side-lobes. The Third kind is shewn in the unsymmetrical shapes of the Side-lobes.

To render this still more clear: the three lobes, *i.e.* No. 1 the central one, and Nos. 2 and 3 of the left-hand half, are isolated in figs. 16B, 16C, and 16D. From these it will be seen that the Central-lobe (No. 1), as a whole, is symmetrical; while each Side-lobe (Nos. 2 or 3) is unsymmetrical.

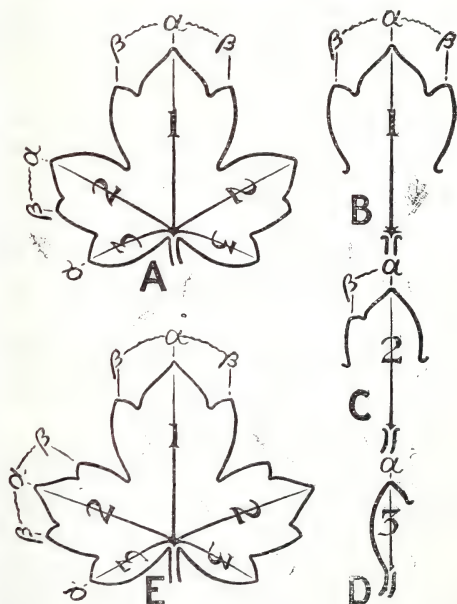


FIG. 16.

The Suppression of the attendant Teeth, on the nearer-side of the Lobes, enables the Side-lobes to be closer to the Central-lobe, and so conduces to render the Leaf-shape simple and

beautiful. If a Side-lobe were furnished with the same number of attendant-teeth as the Central-lobe (as shewn in fig. 16E, Lobes No. 2) then the Side-lobes are pushed-out, disturbing the general curve; and there is a distinctly-felt loss of Beauty, both in the Side-lobe itself, and in the general Mass-shape of the Leaf, which is now no longer simple and easily-understood.

From the above, and many other Leaves which the student can collect for himself, it may be deduced that in Nature the principle of Subordination is almost universal; and that this conduces to the simplicity of Leaf-shape which is so beautiful, alike to the æsthetic Eye and the reflective Mind. (See § 34.)

(z) PROPORTION, of the parts to each other in the same ratio as the wholes, is a result of the Exhaustion affecting each. (See § 35.)

(A) THE NUMBER OF TEETH on each Lobe varies very much in Nature, from the fewness on the Maple to the numerousness on the Blackberry. This affords a suggestion for Variety in the amount of detail which may be added to the Leaf-edge, or, in other words, for Gradation in Richness. (See § 36.)

(Z) LATERAL ACCRETION is another principle in Leaves. It has been shewn how in the degeneration of leaves the portions at the sides are the first to be lost, and the central portion is the ultimate survivor. Conversely, in the first evolution of Plant-species, the single Central-leaflet was the ancestor; and the lateral portions were evolved in the same sequence as their nearness to the centre would suggest. Hence the Accretion is *lateral*. (See § 37.)

(m) EXHAUSTION in the Leaf is a result of the same principle or law as that in the Stem, and this causes Gradation in Size. (See § 38.)

(n) REDUNDANCE OF LEAF-EDGE is observed in some Leaves; and this quality gives beautiful variety in the drawing and surface-modeling. (See § 39.)

(o) VENATION, or the arrangement of the Veins in the leaf, is in Nature very varied and interesting. It has been observed to be often analogous to the arrangement of the Branches in the Tree. The two great Classes—the Exogens and the Endogens—follow essentially different methods. In Exogens: the Veins start, at an angle, from the Mid-rib, and diverge towards the Leaf-edge, as in the Oak, &c. In Endogens: the Veins start in a parallel disposition, from the Base of the leaf, grow in quasi-parallel directions, and converge at the

Apex, as in the Grass, Lily, &c. The Artist has these two methods of Starting, and two Directions-of-Growth, to choose from.

In EXOGENS: the divergent Growth renders the Lobation more clear. Thus in fig. 15, i, each Leaflet is provided with a Primary-vein, growing, from the common divergence at the top of the Stalk, to the point. In fig. 15, g, in which both of the lower Leaflets have anastomosed and degenerated into Lobes—their Veins have also degenerated into Secondary-veins (*i.e.* they grow, not from the top of the Stalk, but from the Primary-veins of the surviving Leaflets). In fig. 15, e, in which these Side-lobes have not been formed, the Side-veins, also, are absent. In fig. 15, b, in which the Side-leaflets of fig. 15, e, have degenerated into Side-lobes—the Primary-veins have followed. OUTWARD-growth will be seen to be the law in the Lobes. In fig. 15, b, a series of Tertiary-veins grow from the two Secondary-veins; and the great majority of these grow *outward* towards the Leaf-edge, thus shewing the *lateral* accretion of the leaf. The upper Veins, nearest to the Apex, are generally more acute in the angle of divergence; the lower ones, nearer to the bottom, becoming gradually more obtuse; and this produces a kind of Radiation, which is utilised and improved-upon in Art.

In ENDOGENS: the parallel Starting in Sessile-leaves, gives a firm effect, which is very suggestive (§ 40).

(p) CORRUGATION exists in such Leaves as have a redundancy of Lamina between the Ribs. In these cases: the Lamina, being too broad for the width between the Ribs, cannot be spread *flat* when the Leaf is laid-down, but makes a Wrinkle, which extends from the Sinus, inwards, towards the base of the Leaf, *e.g.* in the Vine, &c. (§ 41).

§ 28.—ARTICULATION.

The PETIOLE-articulation is used by the ornamentist, chiefly for the Leaves of Vermiculate-tendrils, fig. 48C; but also occasionally for those of the Stems in such small panels as that shewn in fig. 28, which are therefore termed Stalk-leaves. They were much used by the late Mr. W. H. Rogers, in the Tail-pieces he drew for the "Art Journal", in 1851, *et seq.*

The SESSILE-articulation is used for the Leaves that form sheaths round Stems, of all sizes, figs. 29, 49, 36, &c., which are therefore termed Sheath-leaves, *q.v.*

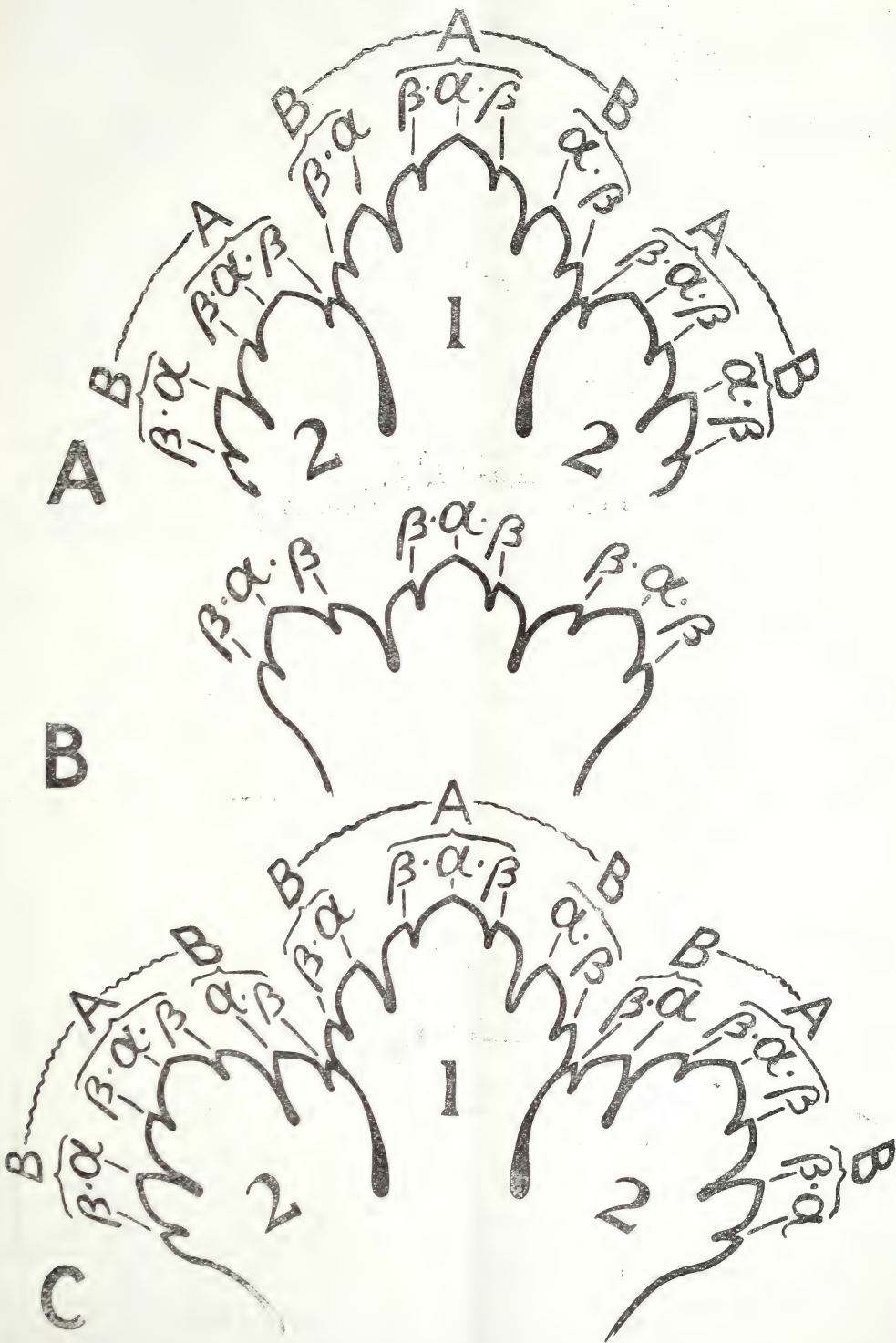


FIG. 17.

§ 29.—LEAF-SHAPE.

The LANCEOLATE has been selected, by Artists in the best periods, as the Mass-shape of their larger leaves. It is simple in itself; and capable of great variety of leaf-edge within that general shape. The leaves of the Bay, if the lower half be cut-off, will give the general shape. The greatest breadth will then be at the lower end; the edges are (approximately) parallel for a short distance up; they are thence tangentially curved towards the apex of the leaf; the curve is always convex, and increasing in amount of curvature; and the apex is Acuminate. Figs. 14, 19, 24 to 26, &c., are all drawn in this shape, which is that of the Korinthian-leaf (laid flat), and is the most susceptible of artistic treatment of all. The lower end of the pilasters in the Madeleine Church at Paris (in France) contains a Leaf which is very faulty in mass-shape; and the student should not found his style on that example.

The ACUMINATION may sometimes cause a difficulty in Circular-rosettes, &c.; but that is overcome by curling-over the Leaf-end, or evaded by bending it sideways. (See the Rosette.)

§ 30.—THE LEAF-EDGE: SINUATION.

The SINUATE edge being a characteristic of water plants: the leaf which is thus treated is called a Water-leaf; and this name will be used in treating of it. Each Sinuation touches the Mass-line of the Leaf. Their Shape is similar in every Tooth. Their Size also is approximately equal, the Length of the sinuations, and also their Depth (*i.e.* the amount of their deviation from the mass-line of the leaf), is proportional to the Breadth of the leaf at the place where each one occurs. They will therefore be gradated in Size, from the large ones near the bottom of the leaf to the smaller ones near the apex.

The LEAF-SURFACE is generally much corrugated, as if in compensation by variety of *relief* for the absence of variety in *edge*.

§ 31.—THE LEAF-EDGE: SERRATION.

The SERRATE edge was the first expedient adopted to obviate the hardness of the entire leaf. Each Tooth touches the Mass-line of the leaf, as in fig. 13A, or the Mass-line of the Lobe, as in fig. 13B. Their shape is identical in every Tooth. Their Size will be proportional to the Breadth of leaf, as in the last section. Each tooth is individualised; and each appears

as important, in size and in position, as its neighbours; hence the Leaf is like a Government in which every man is "as good as any other man", which is therefore no government at all; and it is not interesting to the ornamentist.

The LEAF-SURFACE is generally treated with a V-groove in each Tooth, as shewn in the above figures.

§ 32.—THE LEAF-EDGE: BI-SERRATION.

The BI-SERRATE edge is an improvement on the first treatment, having more variety. The Teeth are arranged in groups (Sub-lobes); each tooth touches the Mass-line of its group; and the Mass-line of each group touches the Mass-line of the Leaf, as shewn in fig. 13C.

§ 33.—THE LEAF-EDGE: LOBATION.

The LOBATE edge is a great improvement on the last treatment, having more Variety and Interest. The Teeth are arranged in Groups or Sub-lobes; and each Tooth touches

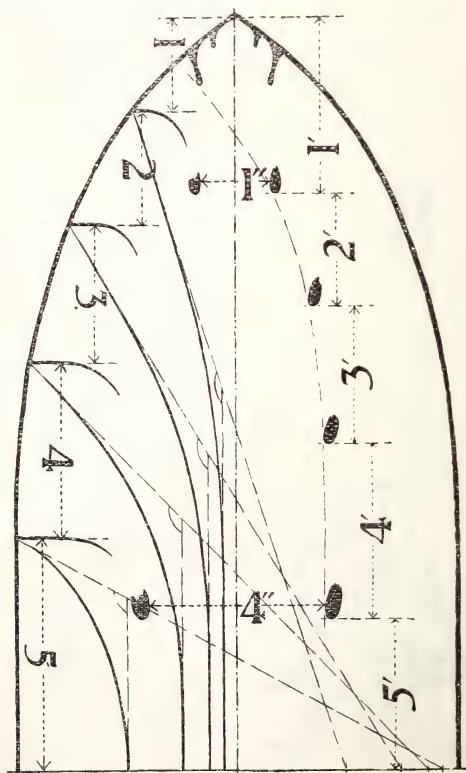


FIG. 18.

the Mass-line of the Sub-lobe of which it is a portion. Similarly: each Sub-lobe touches the Mass-line of the Lobe of which it is a portion. And, similarly, each Lobe touches

the Mass-line of the Leaf. Thus the Teeth may be likened to persons who are members of Families; the Sub-lobes, like families which are collected into Tribes; and the Lobes, like Tribes that are collected into a nation. Thus is tracible the gradual placing-together and building-up from the Tooth to the Leaf; as from the Individual to the Nation.

In Shape: there is great Variety, each Tooth being classified either as a Centre-tooth— α —(see fig. 14) or a Side-tooth— β —; each Sub-lobe being either a Centre-sub-lobe—A—or a Side-sub-lobe—B—; and each Lobe being either a centre-lobe—1—or a Side-lobe—2, 3—&c. In size: there is firstly Variety between the Central features— α , A, and 1—and their respective Side or “attendant” features— β , B, and 2, &c., the former being larger than the latter; and secondly the Gradation, as mentioned in § 30.

The PRIMARY-SINUS, between adjacent Lobes, varies in Number according to that of the Lobes. The Position is governed by the Sinus-line, following the curve of the Mass-line of the Leaf, and drawn at a small distance inside it, commencing at the lowest Sinus. This initial Distance is varied, according to the Richness of the leaf (see § 36); and in all cases it is diminished as the Breadth of the leaf diminishes towards the Apex (fig. 18). If this Distance should be too great: then the Leaf would be too much cut-up; and Breadth-of-effect would be lost. If this Distance should be constant (*i.e.* if the Sinus-line should be parallel) to the Mass-line of the Leaf: then, the Lobes remaining constant in breadth while the Leaf diminishes, Proportion would be lost. If this Distance should increase, instead of diminishing; then the effect would be still worse. Lines analogous to these Sinus-lines are also drawn to govern the position of the Secondary-sinus and Siniculus.

The HEAD of the sinus may be an arc of a Circle; and this fact has been often utilised by marble-carvers to save time by using the Drill.

The LENGTH of the SINUS (*i.e.* the amount of cutting-in) is a matter of Judgement; and can be determined only after observation of the best examples. The breadth of the un-cut Nucleus of the leaf is of more importance than that of the Lobes; hence it is better to set-out the Nucleus-breadth between the lowest pair of Sinuses (4" in fig. 18), and work from that.

The SECONDARY-SINUS, if made the same length as the Primary-sinus (*i.e.* to touch the

Sinus-line), as in fig. 19, would spoil the effect of the Leaf.

The SINICULUS, if made the same length as the Sinuses, would destroy the effect of the Leaf.

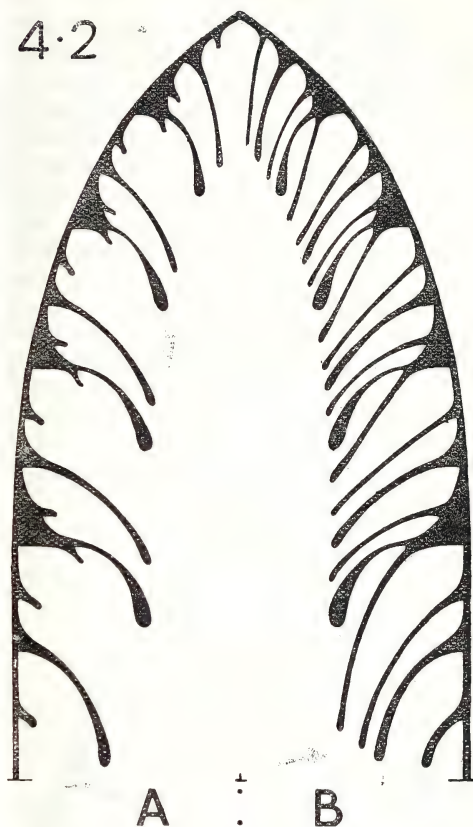


FIG. 19.

The THREE TREATMENTS may be compared in figs. 14, 19A, and 19B; of which it may be said that fig. 14 is like a well-ordered Nation; fig. 19A is like a nation in Factions; and fig. 19B is Ragged and Revolutionary.

The NUMBER of TEETH, in the Outer-edge and the Inner-edge of each Side-lobe, will vary. The Central-lobe is symmetrical; and is treated with the same number on each edge. The Side-lobe (as mentioned in § 27 *h*) is unsymmetrical; and each one is shorter in the Inner-edge towards its Superior-sinus, and longer on the Outer-edge towards its Inferior-sinus. This Inequality in length of the two edges or “Coasts of the gulf” has been treated in three different methods:—

(a) By an equal number of unequal-sized teeth; as shewn in fig. 20A;

- (b) By an *unequal* number of *equal*-sized teeth; as shewn in fig. 20B; and
 (c) By an *equal* number of *equal*-sized teeth, leaving the portion of Outer-edge, next the Inferior-sinus, *bare*; as shewn in fig. 21.

In these examples: (a) is displeasing; (b) is according to Nature; and (c) is mannered. The second method (b) is therefore adopted.

TO DISTINGUISH the various Methods of treating the leaf-edge: the first Side-lobe, marked—2—in fig. 14, is taken as the model; the Number of Teeth on each edge is counted (considering the chief or Central-tooth—*a*—as belonging to both Edges); and that of the Outer-edge is placed first; thus fig. 14 shews a “4·2 leaf”. Sometimes the Number of Teeth is increased according as the Lobes increase in Size towards the bottom of the leaf, as in fig. 20B, in which the Central-lobe contains four Teeth, the No. 2 Lobe has five on the Outer-edge and three on the inner, No. 3 has six and four, No. 4 has seven and

less number, No. 3 has a greater) is termed a “5·3 + leaf” (see also fig. 13B). Hence also: fig. 21 is termed a “4·4 leaf”; fig. 24 is a “6·4 leaf”; fig. 25 is a “9·6 leaf”; and fig. 26 is a “13·9 leaf”.

The “4·4 LEAF,” shewn in fig. 21, is not

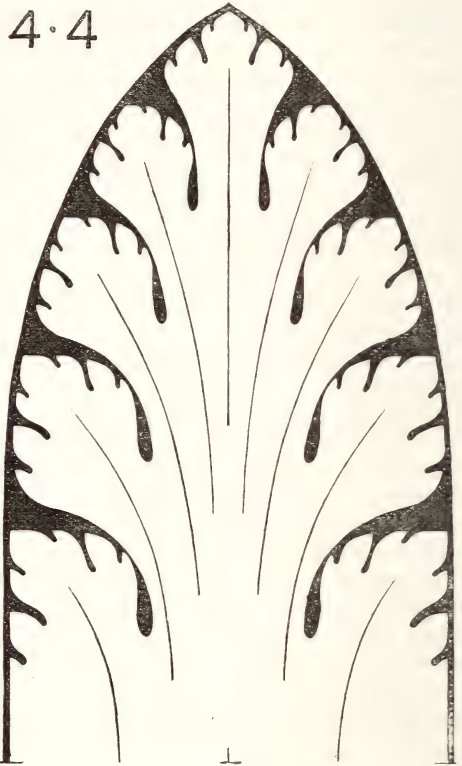


FIG. 21.

like the general-average of Nature; the unserrated portions of the edge are bare; there is no Sub-ordination shewn by the Side-lobes; and the whole is mannered and displeasing. Any attempt, to treat a Side-lobe or other side portion in a Symetrical manner, must end in a similar failure.

§ 34.—THE LEAF-EDGE: SUBORDINATION.

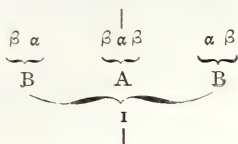
SUBORDINATION is equally important in the Artificial-leaf. On comparing fig. 17 with fig. 16, the analogy, between the principle as existing in Nature and as deduced and applied in Art, will be apparent. Thus, in fig. 17A (which contains the upper Lobes of the 4·2 Leaf of fig. 14), the Lobe No. 1 consists of a Central-sub-lobe A and a Side-sub-lobe B at each side. The Side-sub-lobe B consists of a Central-tooth—*a*—and a Side-tooth



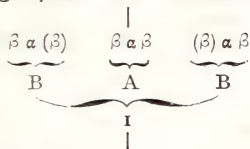
FIG. 20.

five. This leaf (taking the No. 2 as model, and considering that while the No. 1 has a

—β— towards the outer-edge. Hence the formula of the Lobe No. 1, in fig. 17A, is:—



If the Side-sub-lobe B were furnished with an attendant-tooth —β— on the inner-edge, as shewn in fig. 17B, with the formula:—



then the Side-sub-lobe is pushed-out; and the simplicity, of the Mass-shape of the Lobe, is destroyed.

Similarly, the formula, for the Central-lobe 1 and the Side-lobe 2 of the 4:2 leaf in fig. 14, is:—



If the Side-lobe 2 were furnished with a Side-sub-lobe B on the inner-edge, as shewn in fig. 17C, with the formula:—



then the Side-lobes 2 are pushed-out; and the simplicity, of the Mass-shape of the Leaf, is destroyed. The Madeleine leaf before mentioned is a flagrant instance of this faulty treatment.

In the above Formulæ: the side-teeth and side-lobes, which cause the Faults, and should be suppressed, are enclosed in Brackets. It may here be said that as, in a society, each Individual suppresses a little of self for the unity of the Family; and each Family suppresses a little of its importance for the unity of the Whole—so in a leaf each Tooth or each Sub-lobe is a part of a Whole; and each suppresses a little of its size and its symmetry, and is subordinated for the fair perfection of the complete Leaf.

It may be further said that though the treatment of the Lobe of fig. 17B, or Leaf of fig. 17C, shews too much pride, and is therefore faulty: yet the treatment in fig. 13C, which

shows too much humility, is not so faulty, though it would cause a dull effect in a large Leaf.

The SHAPES of the TEETH may be as infinite in Variety as those of Nature; subject to the reservation that, in the Bi-serrate treatment of Leaf or Lobe-edge, it should be a convex or “containing” shape; and the Siniculus, &c., should be narrow in proportion to the breadth of the Tooth. When the Tooth is concave in shape, or the Siniculus is broad: then the shape of the Ground-interstice attracts the attention; and the effect is not clear. This does not apply to the foreshortening in Sheath-leaves, *q.v.*

§ 35.—THE LEAF-EDGE: PROPORTION.

The PROPORTION which exists in Nature, is an important principle in Art. The Lobes are proportional to the breadth of the Leaf, diminishing in size as Leaf diminishes. The smaller sub-divisions, down to the Teeth, are similarly proportional to the size of their respective Lobes. If the successive Teeth remained constant in size, while the Leaf diminished: then they would appear to grow larger towards the Apex; which would produce a bad effect.

Miscellaneous.

CULTIVATION OF BEET AND MANUFACTURE OF SUGAR IN BOSNIA.

A recent report on the sugar industry in Bosnia gives some details on the production and consumption of that necessary article in Bosnia and the Herzegovina, where it is stated that the total annual consumption of sugar of all kinds is variously estimated at from 30,000 to 45,000 quintals. A sugar factory, it is stated, has been recently established by the local Government at Usora, near Doboj, on the Brod-Serajevo line of railway. The buildings were commenced in June, 1892, and in January, 1893, the factory was in full work. This establishment covers an area of about 12 acres, and has been built on the most approved principles. The machinery is of the best kind, with all the most recent improvements. Up to the present only crushed sugar, known in commerce under the name of “Pilé,” has been produced, but now a refinery has been added to the establishment, and loaf-sugar will also now be produced. All the raw materials employed in the factory are native products. The beets are grown in the surrounding districts, the lime is burnt in the neighbouring valleys of the Spreca and the Usora, and the coal is

drawn from the mines of Krekà and Tuzla. Three hundred workmen are daily employed on the establishment, nearly all of whom, including many overseers, are natives of Bosnia. They distinguish themselves by their intelligence, sobriety, orderly conduct, punctuality, and diligence. About 1,800 fl. (= £150) are paid weekly in wages, and in case of sickness the workmen receive medical attendance and medicine gratis. A sick fund is also being gradually formed for the support of those who are temporarily or permanently disabled. The factory was built for a daily consumption of 2,000 to 2,400 quintals of beets, but it is found that even a larger quantity can be dealt with. Depots have been established at seven different stations on the Brod-Serajevo line, where the growers deliver their beets, whence they are brought, as occasion requires, to the factory. Great difficulty was experienced at first in introducing the cultivation of the beet among the peasantry, and it was only effected by the greatest perseverance on the part of the authorities, and at a considerable cost to the Government. Implements were distributed gratis, instruction in the mode of culture was imparted by skilled agriculturists, and promises of purchase at remunerative rates were made to the growers. In spite of all these inducements, however, only 170 hectares, or 420 acres, were sown with beet in the first year, which produced about 23,000 quintals of roots. In the following year (1892) the extent of land sown had risen to 860 hectares (2,125 acres), which produced about 160,000 quintals of beets, and during the past year no less than 2,700 hectares (6,672 acres) were sown, and over 350,000 quintals of beets delivered to the factory, being an increase of more than 1,600 per cent. in the course of three years, so that the success of the enterprise seems now to be fully assured; more than £30,000 were paid last season for the purchase of beets, and the peasants therefore finally realise the advantages of this branch of culture.

Another benefit to the country from the introduction of this crop will be feeding and fattening of cattle. In this the Government is also setting an example. About 50 per cent. of the beets used at the factory are returned to the peasants in the form of paring and refuse, and this makes good fodder for cattle. Stall-feeding and fattening of cattle for the market has never been practised in Bosnia and the Herzegovina, but will now probably, through the cultivation of the beet, be gradually resorted to. Manuring of the fields is also very little practised in that country, but the absolute necessity of so doing to obtain remunerative crops of beetroots will be recognised by the peasants, and necessitate the stall-feeding of cattle, which will not only be another source of profit to the agriculturist, but will tend likewise to improve the breed of cattle by inculcating the habit of giving them more care and better food during the winter months than has hitherto been the custom.

Finally, the establishment of this sugar factory will be no inconsiderable benefit to the revenue. The

excise duty on sugar is 11 fl. (18s. 4d.) per quintal; and the total amount, therefore, paid to the local exchequer for the 26,000 quintals produced last year was 268,000 fl., or £23,800.

VINE DISEASE IN KASHMIR.

The following note, taken from a memorandum by Mr. W. R. Lawrence, Settlement Officer, Kashmir State, is published by the Indian Government as one of their Agricultural Ledger Series:—

In 1889, Mr. Lawrence was desired to assist the Darbâr by superintending the State vineyards. It was then generally believed that the decay of the vines was due to lax management, and it had not been suggested that the real cause of the evil was phylloxera. At the beginning of 1890, Monsieur Peychaud, who had been given charge of the vineyards as well as the wine factory, reported that he had described the symptoms, and had sent specimens of the rootlets of deceased vines to his father, who is a vine-grower in the Bordeaux district, and that he, after consulting other experts, had pronounced the disease to be phylloxera. Inasmuch as the vines were originally imported from the Bordeaux country, it appeared *prima facie* possible that, just as Bordeaux had suffered from phylloxera, so the vines imported from Bordeaux might have brought the disease with them.

To meet the ravages caused by phylloxera in France, vine-growers imported a strong, healthy stock from America, which is able to resist the disease. At the end of 1890, by the assistance of the Government of India, a large number of rooted American vines and cuttings were received, and were taken charge of by Signor Benvenute, the trained vine-grower, who joined the service of the Kashmir State at the end of 1890. One vineyard, the Jhid vineyard, which was destroyed by phylloxera, has been re-planted with American vines, and they look extremely strong and well, and in the next planting season, the Chashma Shâhi vineyard will be re-planted with American stock. Of the various kinds imported, the Riparia has been the most successful. Had any doubts as to the disease being phylloxera existed, they would have been removed by the fact that, in the spring of 1891, Signor Bassi and Signor Benvenute, both of whom hold certificates of proficiency in vine culture, often demonstrated the phylloxera insect on the roots of the old vines.

As regards Dr. Watts' suggestion that the Indian wild vine may prove an efficient substitute for the American vine, the experiment is being tried, and a large number of wild vines have been budded with French vines. It is too early yet to say whether the wild vine will be able to throw off the phylloxera in the same way as the American stock throws it off. So far the experiment has not succeeded, for 900 wild vines budded with French vines died this year (1892) from phylloxera.

Journal of the Society of Arts.

No. 2,188. VOL. XLII.

FRIDAY, OCTOBER 26, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Proceedings of the Society.

CANTOR LECTURES.

ARTIFICIAL FOLIAGE IN ARCHITECTURE.

BY HUGH STANNUS, F.R.I.B.A.

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Lecture III.—Delivered March 5, 1894.

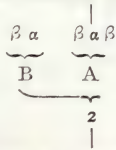
§ 36.—THE LOBE: GRADATION IN RICHNESS.

The NUMBER of TEETH in each Lobe has been hitherto considered as being normal in the "4·2 leaf"; but this number may be increased, up to about thirteen Teeth on the Outer-edge, and nine teeth on the Inner-edge. The increase may arise from the following causes:—

- Increase in the Size of the leaf: thus fig. 14 might serve for a Leaf of six inches height; and fig. 26 for one of thirty inches (the Architect's reason);
- Fineness-of-grain in the Material: thus fig. 14 might be executed in ebony; and fig. 26 in sandstone (the Craftsman's reason, see also figs. 52 and 53); and
- Desire for Richness and multiplicity of detail (the Patron's reason).

Some examples of this increase are shown in figs. 22 and 23, which are Lobe No. 2 of the L.H. half of the Leaf. They are distinguished by the Numerals which indicate the number of Teeth on the edges.

In the 4·2 leaf, the formula is:—



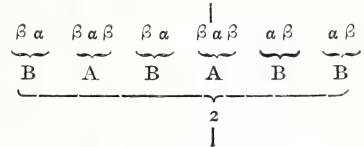
This leaf might be six inches high; or if the whole series were of one height, it might be of ebony (see fig. 14 for complete leaf).

In the 6·4 leaf, the formula is:—



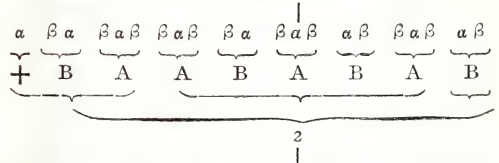
This leaf might be ten inches, or in Walnut (see fig. 24 for complete Leaf).

In the 9·6 leaf the formula is:—



This leaf might be eighteen inches, or in Marble (see fig. 25 for complete Leaf).

In the 13·9 leaf, the formula is:—



This leaf might be thirty inches, or in Sandstone (see fig. 26 for complete Leaf).

The Leaf in fig. 59 (which is generally called the Albertolli-leaf, from the name of the Artist, circa 1805, who arranged it) is still richer. The number of Teeth on the outer and inner-edges of the successive Lobes is as follows:—

No. 1	10	
„ 2	? 11	? 10
„ 3	? 13	? 11
„ 4	15	12
„ 5	17	13

It would be difficult to class this Leaf: it might be termed "11·10 +"; but classification is perhaps not necessary, as it is almost too rich for general use.

The student should be again reminded that there is no virtue in these particular Formulæ; and that they are given only to suggest that there should be some kind of Formula, deduced, and applied.

§ 37.—THE LOBE: NUMBER, AND LATERAL ACCRETION.

The NUMBER of LOBES has so far been assumed to be five; but it should depend on the Length of the leaf.

To DISTINGUISH the varying Number of Lobes in Leaves: they are counted, including the central-lobe, down one side, as is shewn by

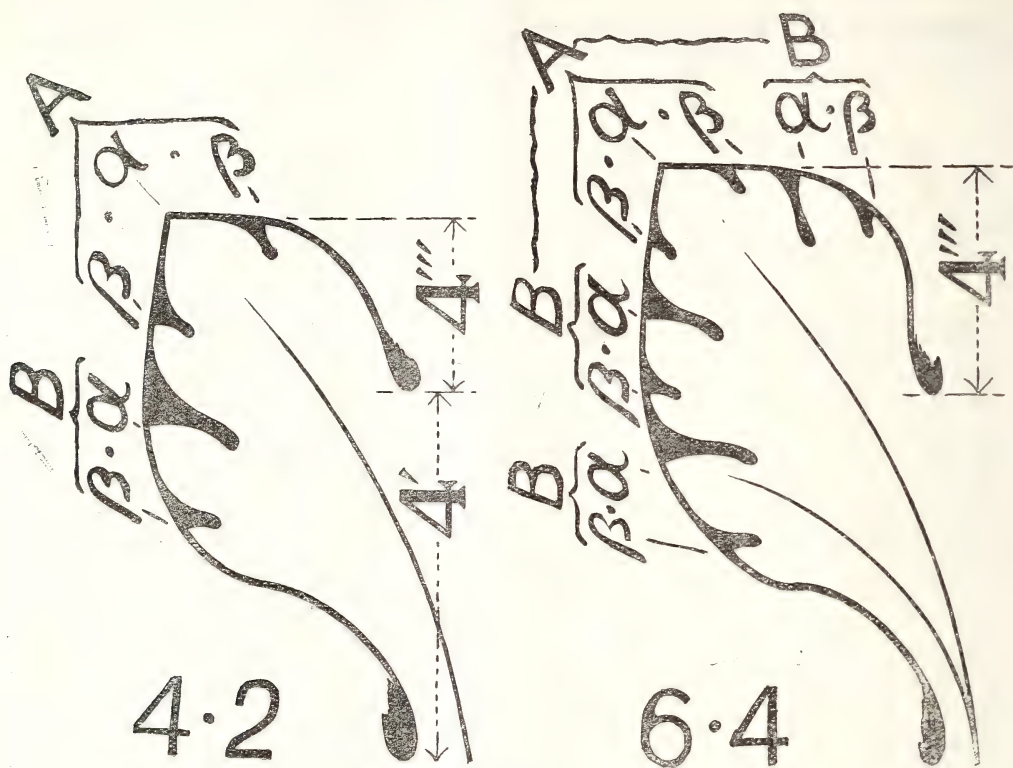


FIG. 22.

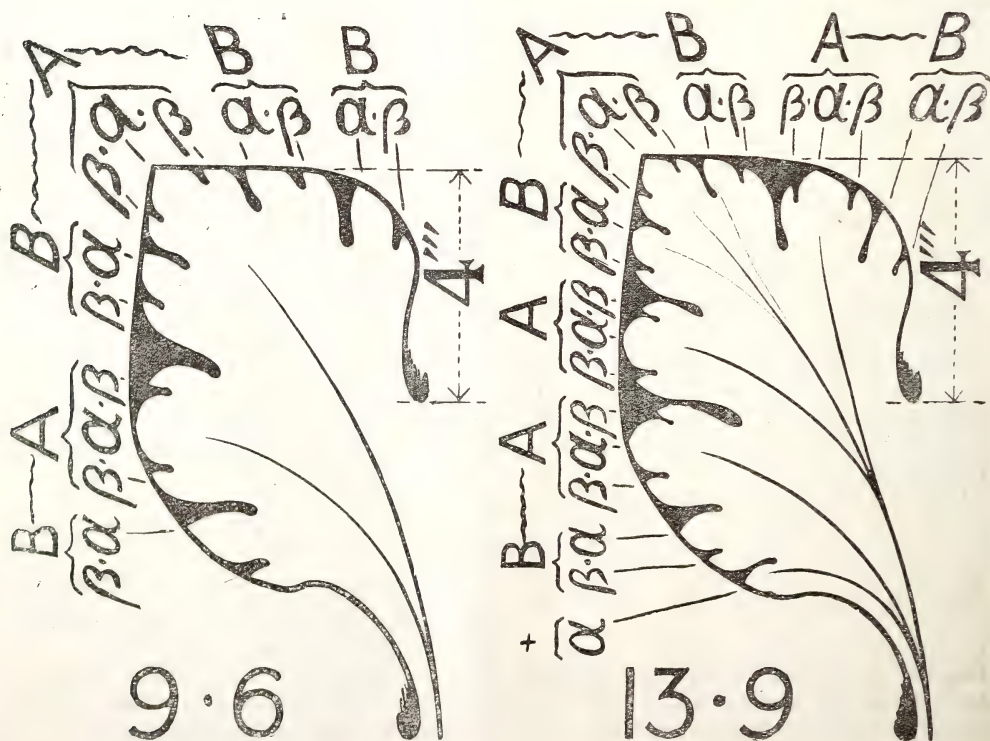


FIG. 23.

6.4



FIG. 24.

9.6



FIG. 25.

the numerals in figs. 14 and 27. Thus, though, including both sides, there are nine Lobes in fig. 14, yet there are only 5 down one side; and hence it is spoken-of as being "five lobes long", and termed a "five-lobed Leaf".

A Leaf may contain any less number, down to *one* lobe. Thus there are five Lobes in fig. 14; four Lobes in fig. 27A; three Lobes in fig. 27B; two Lobes in fig. 27C; and one Lobe in the leaves of fig. 48C.

13.9

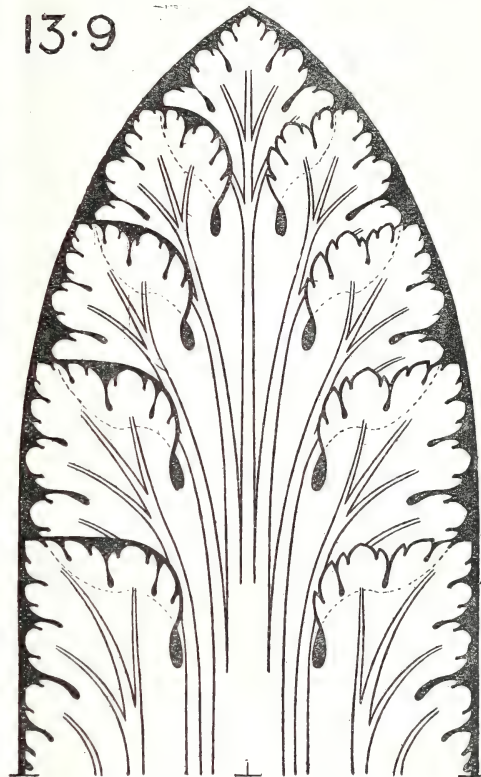


FIG. 26.

The first four of the above Leaves are all drawn to the same height and breadth; and consequently as the Lobes are fewer in Number, they are *longer* in proportion to their breadth. This increase in Length necessitates a corresponding increase in the Number of Teeth: thus the five-lobe, fig. 14 is a 4.2 leaf; the four-lobe of fig. 27A is a 6.4 leaf; the three-lobe of fig. 27B is a 9.6 leaf; and the two-lobe of fig. 27C is a 13.9 leaf.

§ 38.—THE LOBE: GRADATION IN SIZE.

The HEIGHTS of the LOBES, from the Apex of one Lobe to that of the next, measured on

a vertical line, diminish as they approach the Apex of the Leaf, as shewn by the numerals—1, 2, &c.—in fig. 18. The Height of this Leaf is divided into 30 units; and the Breadth, at the Leaf-seat, is $17\frac{1}{2}$ units. The successive Heights of Lobes, with their Differences, are shewn in the following :—

TABLE OF THE HEIGHTS OF LOBES IN A FIVE-LOBE LEAF (FIG 14).

	Height of Lobe.	First Differences.	Second Differences.	Third Differences.	Fourth Difference.
Lobe No. 1...	$3\frac{3}{4}$	$\left. \begin{array}{l} \} 0\frac{3}{4} \\ \} 1 \\ \} 1\frac{1}{2} \\ \} 2\frac{1}{4} \end{array} \right\}$			$\left. \begin{array}{l} \} 0 \\ \} 0\frac{1}{4} \\ \} 0\frac{1}{2} \\ \} 0\frac{3}{4} \end{array} \right\}$
Lobe No. 2...	$4\frac{1}{2}$		$\left. \begin{array}{l} \} 0\frac{1}{4} \end{array} \right\}$		
Lobe No. 3...	$5\frac{1}{2}$		$\left. \begin{array}{l} \} 0\frac{1}{2} \end{array} \right\}$		
Lobe No. 4...	7		$\left. \begin{array}{l} \} 0\frac{3}{4} \end{array} \right\}$		
Lobe No. 5...	$9\frac{1}{4}$				
Total Height.	30				

These Heights are not quite mathematically correct; but they are sufficiently near for all practical purposes as they do not involve any fraction less than $\frac{1}{4}$ of a unit. The Columns of Differences shew that the increase in Height is at an *increasing* ratio.

TABLE OF HEIGHTS IN A FOUR-LOBED LEAF (FIG. 27A).

	Height of Lobe.	First Differences.	Second Differences.	Third Difference.
Lobe No. 1..	$4\frac{1}{2}$	$\left. \begin{array}{l} \} 1\frac{3}{4} \\ \} 2 \\ \} 2\frac{3}{4} \end{array} \right\}$		$\left. \begin{array}{l} \} 0\frac{1}{4} \\ \} 0\frac{3}{4} \end{array} \right\}$
Lobe No. 2..	$6\frac{1}{4}$		$\left. \begin{array}{l} \} 0\frac{1}{4} \end{array} \right\}$	
Lobe No. 3..	$8\frac{1}{4}$		$\left. \begin{array}{l} \} 0\frac{3}{4} \end{array} \right\}$	
Lobe No. 4..	11			
Total Height.	30			

TABLE OF HEIGHTS IN A THREE-LOBED LEAF (FIG. 27 B).

	Height of Lobe.	First Differences.	Second Difference.
Lobe No. 1..	$5\frac{3}{4}$	$\left. \begin{array}{l} \} 4 \\ \} 4\frac{3}{4} \end{array} \right\}$	$\left. \begin{array}{l} \} 0\frac{3}{4} \end{array} \right\}$
Lobe No. 2..	$9\frac{3}{4}$		
Lobe No. 3..	$14\frac{1}{2}$		
Total Height.	30		

TABLE OF HEIGHTS IN A TWO-LOBED LEAF (FIG. 27C).

	Height of Lobe.	Difference.
Lobe No. 1..	11	$\left. \begin{array}{l} \} 8 \end{array} \right\}$
Lobe No. 2..	19	
Total Height.	30	

The HEIGHT of the INNER-EDGE of each Lobe, from the Apex to the Head of the Sinus, measured on a vertical line, as shewn by the numeral—4"—in figs. 22 and 23, is constant in each Leaf; but varies in the different Leaves. Thus: in the Five-lobed 4·2 leaf, it is $3\frac{1}{4}$ units; in the 6·4 leaf, it is $4\frac{1}{4}$; in the 9·6 leaf, it is $4\frac{3}{4}$; and in the 13·9 leaf, it is 5.

The HEIGHT of the NUCLEUS, from the Seat-line to the lowest Lobe-head, varies in the different Leaves. Thus in the Five-lobed 4·2 leaf, it is 6 units; in the 6·4 leaf it is 5; in the 9·6 leaf it is $4\frac{1}{2}$; and in the 13·9 leaf it is $4\frac{1}{4}$.

§ 39.—THE LOBE: OVERLAPPING.

REDUNDANCE of the LEAF-EDGE sometimes causes the Lobes to be so full that two adjacent Lobes cannot lie flat in the same plane; and consequently a portion of one Lobe will be in front of a portion of the adjacent one. This Overlapping gives Variety in the surface-modelling; and has been adopted in the Corinthian Leaf, *q.v.* The AMOUNT of Overlap varies according to the Richness of the Lobe-edge, as shown by a comparison of the

4.2 leaf (fig. 14) in which the Lobes do not overlap, with the 6.4 leaf (fig. 24), the 9.6 leaf (fig. 25), and the 13.9 leaf (fig. 26), in which the Lobes overlap to an extent proportional to their Richness. The INFERIOR-LOBES are in front of the Superior-lobes in these examples; because these shew the Outer-surface of the Leaves (see the Korinthian Leaf).

TECHNICALLY: the simpler treatment, in fig. 14, is the more suitable for *flat* Decoration, *e.g.* Inlay, Stencil, or Colour; but its Clearness may become poor. The Overlapping treatment is better for *relief* Decoration, *e.g.*

Modelling, Carving, or Embossing; but its Richness may cause confusion.

§ 40.—THE SURFACE: VENATION.

The VENATION of the Artificial-leaf is a combination, of the Parallel-starting of the Endogen and the Divergent-growth of the Exogen (§ 270). Fig. 18 shews the setting-out. The Positions of the veins are found by successive Bisection of each half, along the Seat-line of the Leaf, working towards the Mid-rib. In the L.H. half: the Vein of the lowest Lobe starts in a vertical line drawn at the first

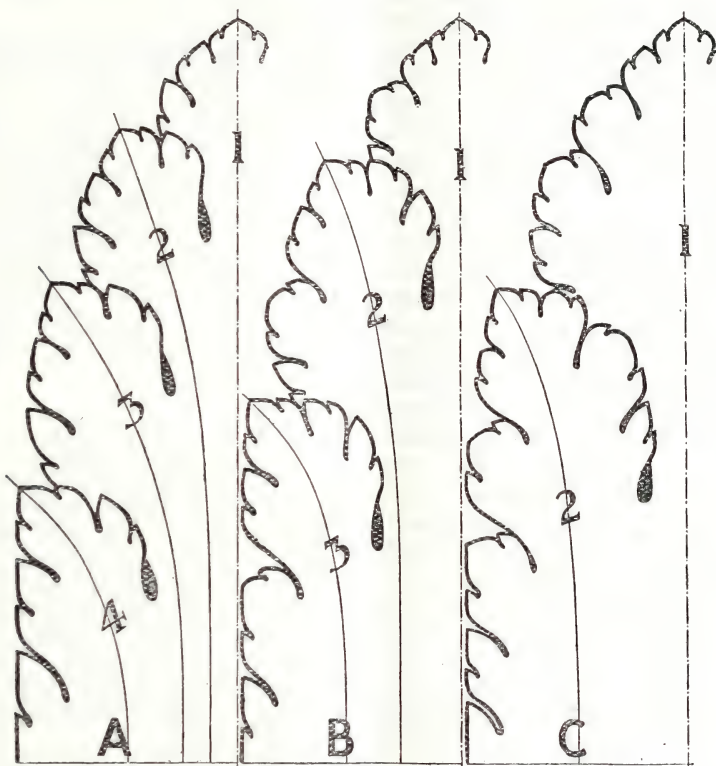


FIG. 27.

Bisection; that of the next-lowest is at the next Bisection; and so on, with so many as are required. The successive Bisections make the leaf richer and firmer in appearance towards the centre. The Directions are found by the successive Bisection of the Seat-line on the other half of Leaf, working towards the Leaf-edge: the Vein of the Central-lobe (No. 1) coincides with the Mid-rib; that of the next highest Lobe (No. 2) is drawn from the Lobe-apex to the first Bisection; that of the next-highest (No. 3) to the next Bisection; and so on, with so many as are required. The Veins

are drawn tangential to the above lines; and this results in the beautiful Radiation which has been likened to that of the Anthemion-ornament. Every tooth is not entitled to be furnished with a Vein or Rib running towards it, but only those which are Central-teeth, marked —a—in fig. 14.

§ 41.—THE SURFACE: CORRUGATION.

The PIPE—r or s—in the right hand, or Inner-half, fig. 14, may have been suggested by the Redundance of the Vine-leaf, or have been invented by some Artist, who felt that



FIG. 28.

his Artificial-leaf needed Variety-of-surface, and also some Lines that should radiate like the Ribs and Veins, and should continue the lines of the Sinus towards the Nucleus of the leaf. It is a projecting Fold of the surface which commences by a slight accentuation of the Leaf-edge round the end of the Sinus, and is continued inwards, towards the Nucleus of the Leaf, following the curved direction of the Veins, as shewn in fig. 55. The Pipes do not ramify like the Ribs, but diminish in breadth and projection, as they approach the centre, until they "die-away" into the Leaf-surface. The Primary-pipes cease on a line, similar to the Sinus-line mentioned in § 33, the position of which is determined by the ornamentist, according as he desires a broadly-treated or a much-corrugated Nucleus. The Secondary-pipes are less in projection and length. The Siniculus is not furnished with a Pipe.

§ 42.—THE TWO TREATMENTS OF LEAF-EDGE.

Of the TREATMENTS of LEAF-EDGE, mentioned in § 26 (e) to (o), the most useful to the Artist, and the most used in Ornament are: (k) the Water-leaf, and (o) the Biserrate-lobe-leaf. The former is broad and simple; and the latter is cut-up and complicate. The strongly-marked difference, between these two, leads to a difference in their Application.

§ 43.—THE WATER-LEAF: APPLICATION.

The BREADTH of EFFECT in this treatment helps to give Mass to a composition; as shewn by the flowers in figs. 49 and 50. It is appropriate for the Sheath-leaves of the smaller Branches and Tendrils, as it may be made less bulky, and consequently clearer in effect, than the more complicate leaf. The Simplicity makes it lower in the scale than its more complicate neighbour: it is therefore used (like the Sepal or Bract in Nature) as a covering and protection, out of which grows the more-highly-developed leaf; as shewn in figs. 46, and 60 (see also the Stem-calyx in figs. 38, 39 to 41, and 49 to 51).

Both Treatments have been, and may be, used in the same Feature; imitating herein

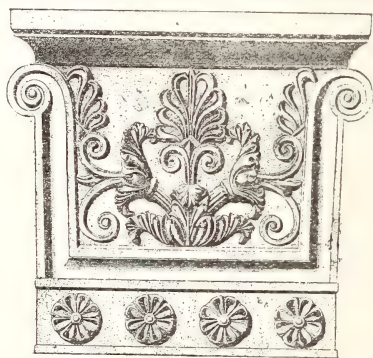


FIG. 29.

the variety of leaf-shape found in the same plant in Nature.

CHAPTER V.—THE SHEATH-LEAF.

§ 44.—DEFINITION.

The LEAF (or Leaves) which enfolds the Stem and the Branches, forming a sheath round them, is hence termed the Sheath-leaf.

§ 45.—THE SHEATH-LEAF: ARTICULATION.

The JUNCTION with the STEM is sessile. With large Stems, it is furnished with a Stem-calyx, q.v.; but with small Branches, this is often omitted.

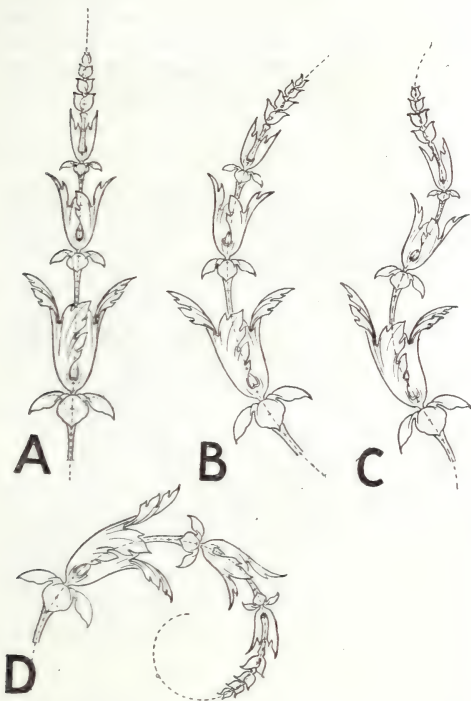


FIG. 30.

§ 45.—THE SHEATH-LEAF: NUMBER, AND DISPOSITION.

ONE LEAF at each Node, as shewn in fig. 1, is sometimes used; but *two*, as shewn in figs. 39, 49, &c., is a more usual number; *three* leaves is not good, because of the loss of Clearness which results. When there is one Leaf at each Node: then the arrangement is generally *alternate* on an Undulate or a Straight-stem. On a Spiral-stem it may be either *constant*, i.e. always on the outer or on the inner side of the curve, or *alternate*.

When there are TWO LEAVES forming a pair at each Node: then they are connate (i.e. conjoined) forming a cup, with an intervening Sinus, as shewn in fig. 39 BB. One

leaf, of each pair, should be larger than the other. When the Stem is Undulate: then the larger one is placed on the outer-side of the curve, as shewn in figs. 11A, 39 to 41, 49, 50, and 51, because the larger Leaf is a sheath to the (larger) Stem (while the smaller leaf is a sheath to the (smaller) Branch); and it leads the eye round the curve better than the smaller one. This results in an arrangement in which each side of the Stem is furnished with the larger and the smaller leaf *alternately*. When the Stem is Straight: then this *alternate* arrangement is generally better. When the Stem is Spiral: then the arrangement may be either *constant*, with the larger-leaf on the outer side of the curve, as shewn in fig. 32; or *alternate*. If the Spiral-stem should grow against the sides of a Panel, as in fig. 12B: then the former arrangement is generally better.

When there are THREE or more LEAVES at each Node: then the arrangement is suitable not for flat decoration, but for independent objects (see the Korinthian-leaf, the Vase-leaf, &c.).

THESE ARRANGEMENTS are subject to modification at the Taste of the Artist. A Stem might be furnished with *two* Sheath-leaves at each Node; while its Branches had only *one*; or the larger-leaf might be arranged on the *inner*-side of the curve; and so on; but, when any arrangement is chosen, it should be followed throughout; i.e. Consistency should be observed.

§ 47.—THE SHEATH-LEAF: CURVATURE.

THE COMMENCEMENT of the Sheath-leaf on an Undulate-stem should not be placed at any *axial* or important point in the Growth-line. Thus the Equator-points (—a, a—in fig. 7E) should be avoided; because then there would be *two* changes (1, in the Direction of the curve, and 2, in the Bulk of the stem) at the same place, which is conspicuous and destroys the repose of the composition. Similarly the Tropic-points —d, d—should be avoided. Hence the choice is limited to the points—b, c, e, and f—; and, of these,—c, and e—are the most suitable. Similarly on a Spiral-stem: the points which are axial, i.e. vertically above and below the Centre of the spiral, should be avoided; and also those that are level with it at the sides.

THE CURVE of the STEM (whether undulate, straight, or spiral) should be followed (as mentioned about the Branch in § 24) for a short distance; and the Sheath-leaf, in parting

from it, should have only a very slight divergence at first, in order that the eye may run-along either curve without any break.

The END of the leaf of an Undulate-stem should avoid the Tropic-point, always; and the Equator-point, if possible; so that the eye, travelling along the lines of the Sheath-leaf, may not be stopped at the Change-in-direction of the Stem-curvature. The end of the Sheath-leaf should be slightly curved in the new Direction taken by the Stem, for the purpose of evincing a kind of sympathy with the Stem, and also to suggest the new Direction to the eye, as shewn in Leaf—E—of fig. 40. On a Spiral-stem: the ending of the Leaf is more free; except when it approaches the sides of a Panel or other enclosed space. In this case: the considerations of Distribution and Parallelism govern the treatment.

An INCREASE in CURVATURE, as a consequence of the Radiation resulting from the search for air and sunshine (*cf.* Radiation § 6), or of the Exhaustion shewn in the decrease of the Leaf (*cf.* § 11), generally occurs. The four degrees of this are:—

- (a) The Simple curve (see the upper Flower-buds of figs. 30A to D), which opens slightly, and then follows the Growth-line;
- (b) The A-verted curve (see the middle Buds), which turns-away from the Growth-line;
- (c) The Re-verted curve (see the lower Buds), which turns-back from the Growth-line (shewing the *inner* surface of the leaf termed the Re-verse); and
- (d) The Salembier-leaf (see fig. 31), which



FIG. 31.

firstly turns-outwards, and then turns-inwards towards the Growth-line. This Leaf-ending, used by the Artist of that name, *circa* 1777, is flabby as if frost-bitten, and wanting in character.

This Increase in Curvature is shewn in fig. 30 to be proportional to the Increase in Length; and when used on the same stem, as in this case, it is an instance of Gradation. The treatments (b) and (c) are very useful in the application of ornament to enclosed-spaces, as shewn in fig. 39B for (b), and in fig. 40D for (c).

§ 48.—THE SHEATH-LEAF: SUBORDINATION.

SUBORDINATION to the FLOWER governs the treatment of the Sheath-leaf. This is shewn in the following manners:—

- (a) Size: the leaf being much less in bulk than the Flower (fig. 50);
- (b) Shape: the leaf being (almost) coincident in curvature with the Stem, while the Flower has a strongly-pronounced shape (fig. 50);
- (c) Colour: the leaf being light or quiet in tone, while the Flower is strong and bright; and
- (d) Relief: the leaf being low or lying flattish upon the ground, while the Flower is high in projection (fig. 47).

If this be not considered: the results may be as unpleasing as those in the treatment of the Leaf-edge.

§ 49.—THE SHEATH-LEAF: PROPORTION.

PROPORTION in BULK to the STEM is an important principle. The Sheath-leaf must, of

course, be larger than the Stem, even when it lies close against it, because of the two thicknesses of the Leaf itself; as shewn in fig. 47. In the case of *large* Stems the Difference-in-bulk is very small; as shewn in the Trajan frieze, fig. 51. In the case of *small* Stems: the Difference-in-bulk may be greater; as shewn in fig. 45. In the case of Tendrils: the Difference-in-bulk may be very great; as shown in fig. 48C, and 51.

PROPORTION IN LENGTH to the CURVATURE is also important. This Length and that of the uncovered stem are together equal to the Nodal-distance.

It will be found, by experiment, that the length of the longer Leaf of each pair should be not less than one-fourth of a circle, 90° , and not more than three-eighths, or 135° . If less: then the Sheath appears mean, and there is too much detail. If more: then the Stem is not clear. The Undulate-stem is divisible,

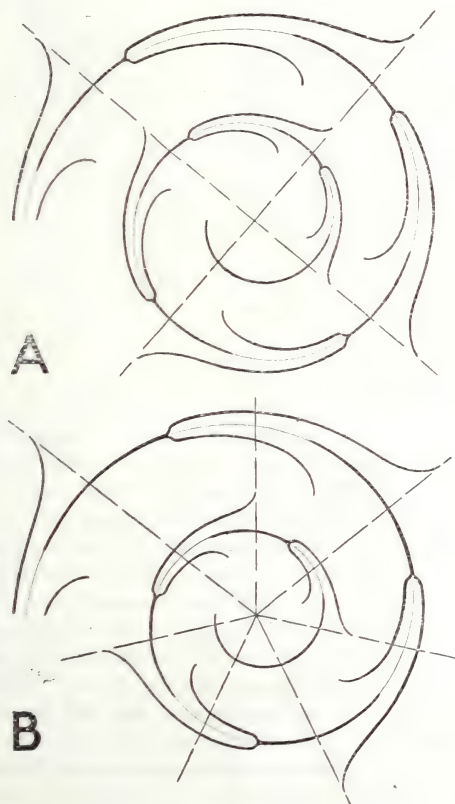


FIG. 32.

at the equatorial-points, into Arcs which are generally about 120° , or one third of a circle. One Sheath is furnished to each Arc; and there is usually a portion of the Stem un-

covered; hence the length will be somewhat less than the third, as shewn in figs. 49, and 50. The Spiral-stem is divisible into quadrants by lines drawn from the centre at 45° with the

6.4

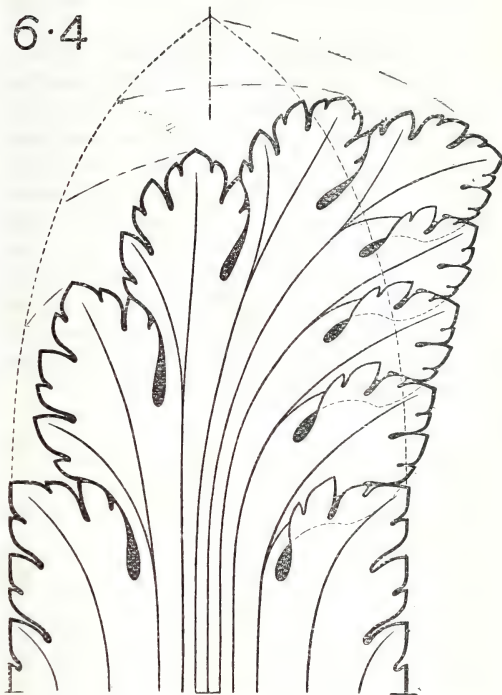


FIG. 33.

horizon, as shewn in fig. 32A. These lines mark the Leaf-ends; and the Proportion, between the Length of each successive Sheath and the Curvature of the portion of the Stem appertaining to it, is always the same; and hence consistent. When, however, the Sheaths on the inner coil of the Spiral are opposite to those on the outer coil, and end on the same lines, as in this case: then they catch the eye; and the effect is displeasing. When the length of the Sheath is two-fifths, two-sevenths, or two-ninths of a circle: then the repeat will not coincide in one revolution, and the Sheaths on the inner coil will not be opposite to those on the outer coil, as shewn in Fig. 32B (which is drawn with the length at two-sevenths); and the effect is better. In either of these methods the principle of gradation in size is apparent.

§ 50.—THE SHEATH-LEAF: NUMBER OF LOBES.

In LARGE WORK, *e.g.* the Trajan-frieze, fig. 51, or the large Console-leaf, fig. 60, there may be five Lobes in each Leaf; in

Smaller Work, *e.g.* the Medici-pilaster, fig. 47, there are four Lobes in each Leaf; and in such Small Work as the Borders, figs. 41, and 49, there are three or two Lobes in each Leaf.

§ 51.—THE SHEATH-LEAF: OVERLAPPING.

With LEAVES in PAIRS to form the Sheaths: one leaf generally overlaps the other; though the simpler treatment, in which they only touch each-other, as shewn in fig. 40A, is also used. With an Undulate-stem: the Larger-leaf is generally arranged on the Outer-side of the curve; and this leaf generally overlaps the smaller-one on the inner-side, as shewn in fig. 40. With a Straight, or Spiral-stem: the arrangement and overlapping are generally alternate. The Overlapping of Lobes, mentioned in § 39, will also generally occur.

THESE ARRANGEMENTS are, however, subject to the taste of the Artist; but Consistency should be observed.

TECHNICALLY: the considerations, mentioned in § 39, govern this also.

§ 52.—THE SHEATH-LEAF: DEVELOPEMENT OF DRAWING.

The NORMAL ATTITUDE of an Artificial-leaf, *i.e.* when symmetrical and flat, is shewn in fig. 14. It may, however, be *bent* to one side while still remaining *flat*, as shewn in fig. 33; or it may be *curled* to the front while still remaining *symmetrical*, as shewn in fig. 59. The last of these is the Korinthian-leaf, *q.v.*; and the second is an intermediate stage in the drawing of the Sheath-leaf.

In comparing fig. 24 (which is a 6·4 five-lobed Leaf) with fig. 33 (which is the same

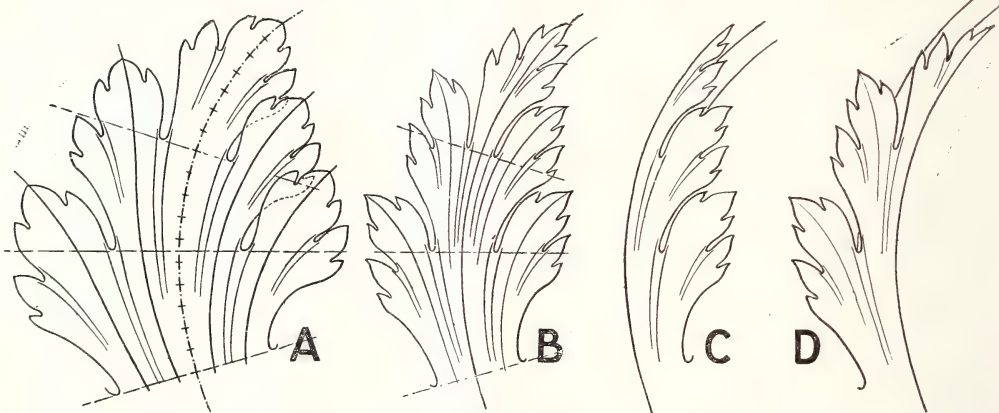


FIG. 34.

Leaf bent towards the R.H. side): it will be seen that, in the latter attitude of the Leaf, the Overlapping of the Lobes is increased on the R.H. side and diminished on the other; and further that the width of the Sinuses is diminished on the R.H. side and increased on the other. The student is advised to cut-out the Leaf in paper; and, bending it, to try this for himself.

Similarly fig. 34A shews the three upper Lobes, of the 4·2 five-lobed Leaf of fig. 14, bent towards the R.H. side. This is the second stage in the Drawing.

Further fig. 34B shews the same Leaf redrawn to a narrower breadth; with the result of making the Teeth narrower and more pointed, as if seen in foreshortening. The Overlapping is omitted for the sake of clearness; but the width of the Sinuses is less on the R.H. side, and greater on the other. This is the third stage.

By DIVIDING the LEAF of the last fig. down the Midrib: the two halves are isolated, as shewn in figs. 34C, and 34D. The former is used in drawing the leaf on the outer-side of the Curve; and the latter for the other. This is the fourth stage; and from this there is an easy transition to the usual Sheath-leaf.

The CURVATURE of the END of Leaf, in figs. 34C and 34D, is the Simple-curve (*a*) of § 47. The AVERTED-curve is shewn, in fig. 35A for the outer-leaf, and fig. 35C for the inner one. The REVERTED-curve is shewn, in fig. 35B for the outer-leaf, and fig. 35D for the inner one.

ONE-HALF of the LEAF (only) is usually shewn in side-elevation: the other half being folded round the Stem, and therefore hidden behind the nearer-half. This other or further-half should not be forgotten; and some additional small portion (*e.g.* the whole of the

Central-lobe) may often be shewn in perspective or three-quarter view, making the Leaf clearer (*i.e.* more understandable) and more interesting and pleasing; as in fig. 36A which is

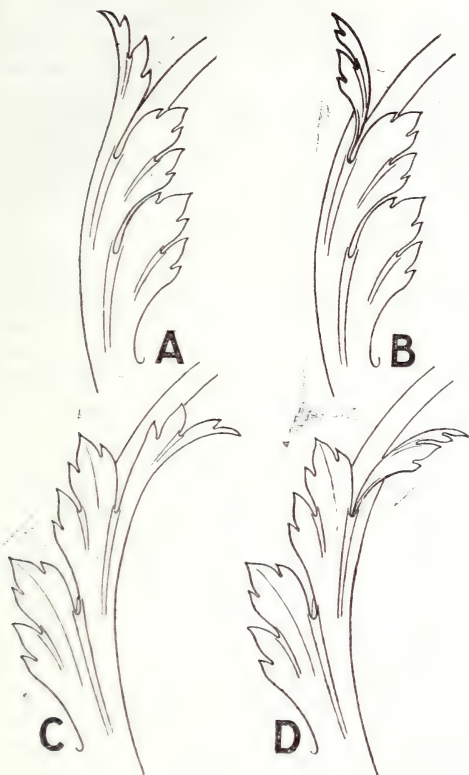


FIG. 35.

an outer-leaf shewing both halves of the Central-lobe, and in fig. 36C which is an inner-leaf shewing both halves of the Central-lobe.

When BOTH HALVES are shewn as in fig. 37: then it is termed a Displayed-leaf. When both halves are shewn, with one in front of the Stem and the other lying against the ground behind it as in figs. 36B and 36D: then it is termed a Folded-leaf. In these two cases: the further-half must agree with the nearer-half in Lobation, Serration, &c.; because both are equal halves of the same Leaf. The Madeleine ornament before-mentioned is very faulty in this: it appears to have been designed, or rather adapted, from the Medici Pilasters, without any Thought or sense of Consistency.

TECHNICALLY: the Half-leaf, as shewn in fig. 35, is the more suitable for *flat* Decoration, *e.g.* Inlay, Stencil, &c., because of its Clearness; and the Displayed-leaf, as shewn in fig. 37, is better for *relief* Decoration, *e.g.*

Carving, Embossing, &c. In Relief-work: the nearer-half of the Displayed-leaf will be in front of the Stem, and it will therefore project more from the ground than the further-half, and that will lie close to the ground, as shewn in fig. 51, and in some portions of the Madeleine ornament before-mentioned. The further-half of a Folded-leaf is sometimes shewn in relief-work, with good effect, lying against the ground while the Stem and the nearer-half are in bolder relief, as seen in Meyer, plate 25, fig. 5, also in some of the panels in the church of S.M. dei Miracoli at Venice, and in figs. 36B and 36D, *seq.*

§ 53.—THE SHEATH-LEAF: VENATION.

The RADIATION of the VEINS adds to the Play-of-line, as well as to the Surface-modelling in Ornament. In a Leaf on the outer-side of a Spiral-branch: the Veins, starting tangentially from near the Midrib which follows round the Spiral and diverging towards the succes-

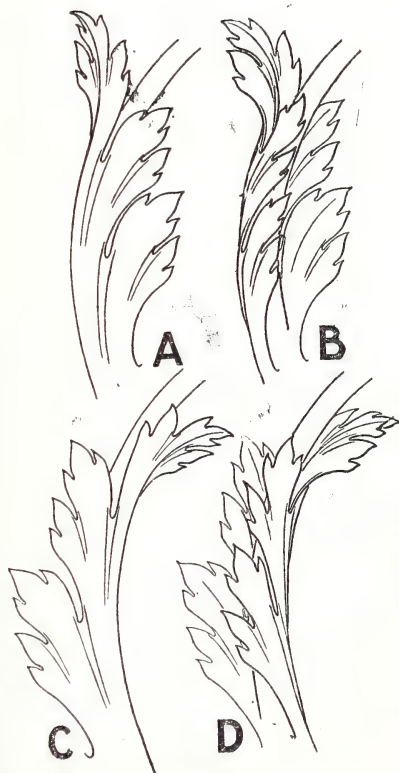


FIG. 36

sive Lobe-centres, make a series of lines, which converge, and lead the eye towards the Centre-flower; thus enriching the Spiral with a Series of related lines, as shewn in fig. 51. In a

Leaf on the inner side: the Veins diverge and lead the eye away from the Centre.

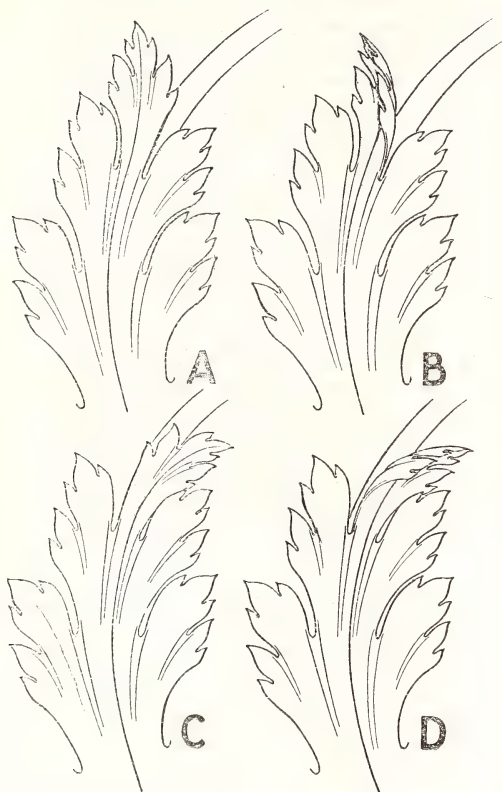


FIG. 37.

§ 54.—THE SHEATH-LEAF: APPLICATION.

SHEATHS are useful in Ornamental-design for reasons which, derived partly from the observation of Nature, and partly from the exigencies of Decoration, may be stated thus:—

- (a) They *hide* the Starting of the Branches; and lead the eye along the Stem;
- (b) They *clothe* the Stem, and give Variety and Interest;
- (c) They give *mass*, and opportunity for Modelling and Colour;
- (d) They give *radiating* Play-of-line, and Richness; and
- (e) They give opportunity for *parallelism* by the Re-verted Leaf-ends.

Examples of all of these Uses may be seen in fig. 51, or in any piece of good Ornament; and the Artist, who endeavours to make a Panel-design without Sheath-leaves, is throwing-away a valuable adjunct in his Work.

General Notes.

FOREIGN EXHIBITIONS.—The representatives of some of the largest Moscow commercial firms are organising an Exhibition of Russian Manufactures, which it is proposed to open at Teheran at the end of the present year. An exhibition, in which Asiatic products will be largely represented, is arranged to be held at Nijni Novgorod, and an exhibition of the products of Asiatic Russia, to be held at Omsk on the completion of the western section of the great Siberian railway, has been talked about. On the 10th of September last, the Prince of Roumania opened a Co-operative Exhibition at Bucharest. This exhibition is almost confined to Roumanian exhibitors, but it is stated that there are 250 foreign exhibitors, of whom the larger part are Austro-Hungarian subjects.

GOLD PRODUCTION IN BRITISH GUIANA.—The report of the Council of the Institute of Mines and Forests of British Guiana for the year 1893-94 states that during the year ended June 30, 1894, the yield of gold has been 137,822 ounces as against 138,279 ounces for the corresponding period 1892-3. The small decrease of 457 ounces is confined to the north-west district, which, taking the Barima and Barama together, shows a falling off of 1,487 ounces. The rivers of the Essequibo basin on the other hand have, with the exception of the Mazaruni, shown a marked improvement. The small total diminution in production, as shown in the last year's returns, is not due to exhaustion, as is shown by the steady improvement of the Potaro, Essequibo, and Cuyuni districts, but is probably the result of the somewhat large investments made in quartz mining companies in 1893. Of the total number of labourers employed 1,109 have been engaged in the development of the quartz reefs. It is not surprising that the north-west district has retrograded, as it is in that part of the colony that the greatest attention has been turned to mining proper, and no less than seven companies have been engaged in development work, which, though promising a rich harvest in the future, cannot be said to increase the colony's production in the present. Again, although there are one or two fairly large and well managed placer mining companies working in the north-west district, the majority of the men engaged there in placer mining are working on small ventures, conducted, to a large extent, by amateurs in gold mining. It appears, from a tabular statement which is appended to the report of the Council of the Institute of Mines, that the production of gold in British Guiana amounted to 250 ounces in 1884; 6,000 ounces in 1886; 32,000 ounces in 1890; and 110,500 ounces in 1891-92.

Journal of the Society of Arts.

No. 2,189. VOL. XLII.

FRIDAY, NOVEMBER 2, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Proceedings of the Society.

CANTOR LECTURES.

ARTIFICIAL FOLIAGE IN ARCHITECTURE.

By HUGH STANNUS, F.R.I.B.A.

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Lecture IV.—Delivered 12 March, 1894.

CHAPTER VI.—THE STEM-CALYX.

§ 55.—DEFINITIONS.

THE STEM-CALYX is the small Cup formed by a Whorl of leaves at the Node below the articulation of the Sheath. In Nature the Leaf-buds, which have protected the growing Branch, fall-back; and it appears to grow through the group; in the same manner as the Sepals of the Calyx fall-back when the matured Corolla appears to grow through them. Hence these leaves may be considered as the Sepals of the more beautiful Sheath-leaves; and therefore the term—Stem-calyx.

§ 56.—THE STEM-CALYX: DEVELOPEMENT.

A BUD, like fig. 38B in side-view and fig. 38C in plan, may be supposed to grow at the end of the Stem. In course of time: this opens, as shewn in figs. 38D and E. The Sepals are displayed, as in figs. 38F, G, and H; or fall-back, as in figs. 38 I, K, and L.

§ 57.—THE STEM-CALYX: SHAPE.

THE CIRCULAR MASS-SHAPE is shewn in all the Plans, figs. 38C, E, G, and K. This results from the fact—that all the Sepals are of equal length—; and it is useful in drawing the Perspective-views, figs. 38H, and L.

The Calyx is more understandable, and more beautiful, when shewn in perspective, as in fig. 38L, and fig. 39, than in side-view.

§ 58.—THE STEM-CALYX: POSITION.

CLOSE to the NODE is the proper position. The curves of the Pipes and Veins of the Calyx-leaves grow-out from the Stem in a tangential

line, like that of the mouth of a French-horn; and the commencement of the Sheath is tangential to them, as shewn in fig. 38L. The Stem-calyx is an *appendage* to the Sheath; and is therefore in immediate contiguity to it, with no intervening Stem.

§ 59.—THE STEM CALYX: NUMBER AND ARRANGEMENT OF SEPALS.

FOUR SEPALS to each Calyx, as shewn in figs. 38B to L, are sometimes used; but *five* Sepals make a more solid and pleasing mass (see in the Flower, § 68). In the large Trajan-frieze, fig. 51, there are *seven* and *eight*; but these are too small in proportion to the Sheath-leaves.

They are CONJOINED at the Leaf-base; with a Sinus between each two Leaves; and when they are reverted, a Pipe extends inwards from each Sinus-head.

INTERMEDIATE-LEAVES (or sepals) are not used; because these Leaves are themselves Sepals; and the intermediate Sepals are reserved for the Flower. If the Division by the Sinuses should cause the Stem-calyx to be too-much cut-up: then the Sepals may be revolved or overlapped.

COINCIDENCE of LINE, between the centre-vein of a Sepal and the Growth-line, is to be avoided, for the sake of clearness.

§ 60.—THE STEM-CALYX: SUBORDINATION.

SUBORDINATION to the SHEATH, governing the Stem-calyx, may be shewn, as mentioned in § 48. The calyx is only a protecting feature like the Sepals; and therefore it should, like them, be a grade lower in the scale of beauty than the Leaves it has covered. Hence it should have not too much variety; and therefore it is composed generally of Water-leaves; as shewn in figs. 41, 50, &c. In large and rich compositions: it is sometimes composed of Biserrate-lobe-leaves, as shewn in fig. 51; but this treatment loses the clearness which would have resulted from the former. The Shape should be *not too pronounced*: the Leaf-curvature may either follow the Growth-line, like (a) in § 47; or be reverted, like (c). If the shape be approximately straight and crossing the growth-line at right-angles, as shewn in figs. 38F, and 38H: then it is too aggressive; and the eye is arrested at the Node, which should not occur unless required by the exigencies of the composition.

§ 61.—THE STEM-CALYX: APPLICATION.

Calices are useful in Ornamental-design for the following reasons:—

- (a) They *clothe* the Stem, and give Variety and Interest;
 (b) They give *mass*, and opportunity for Modelling, or Colour;

- (c) They serve as *centres* from which the Tangential-branching radiates; and
 (d) They give opportunity for *parallelism*.
 Their first systematic use, by the Romans, is

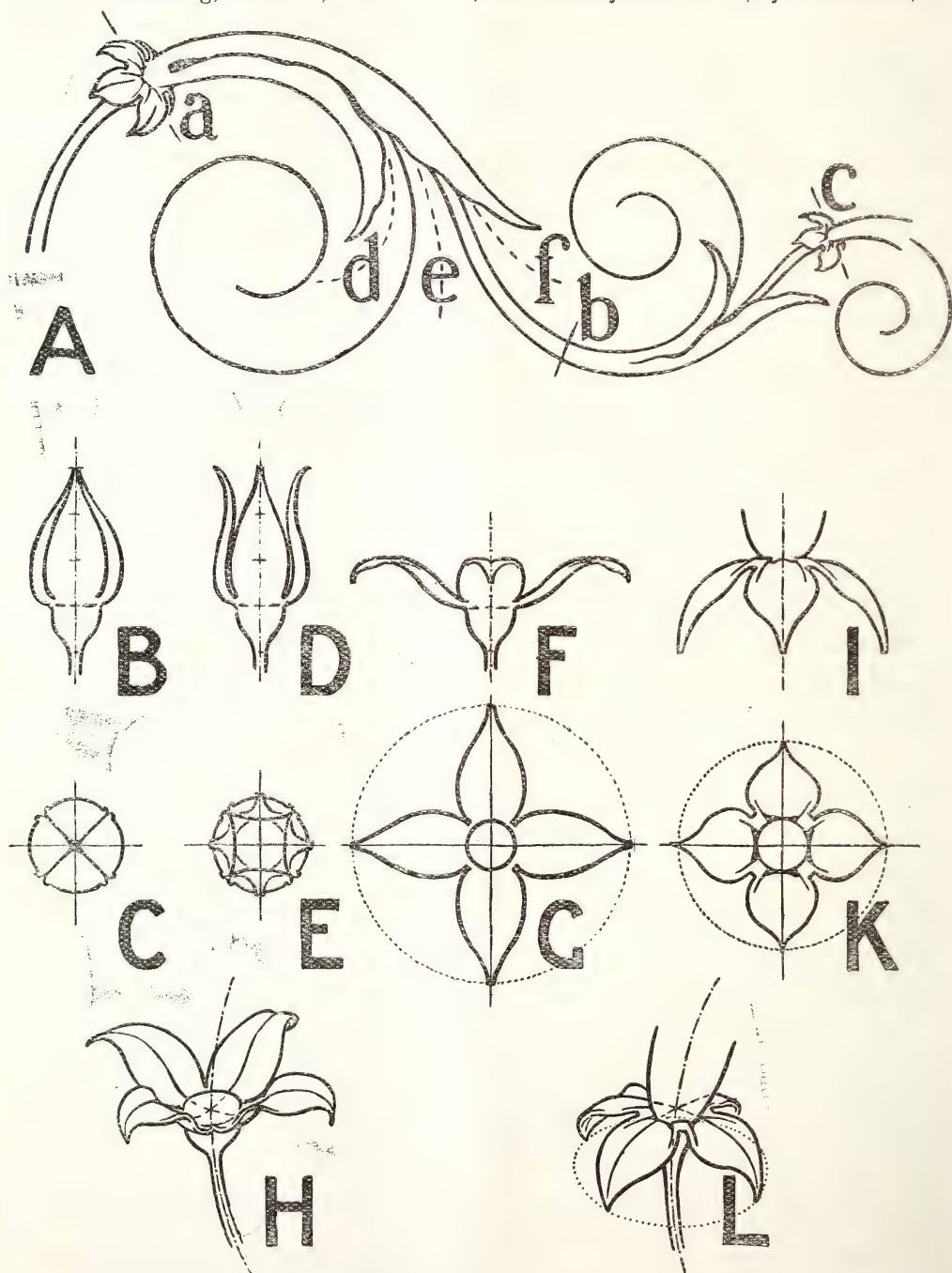


FIG. 38.

quite consonant with the character of that logical and law-making Nation.

CONSISTENCY should govern the use : thus

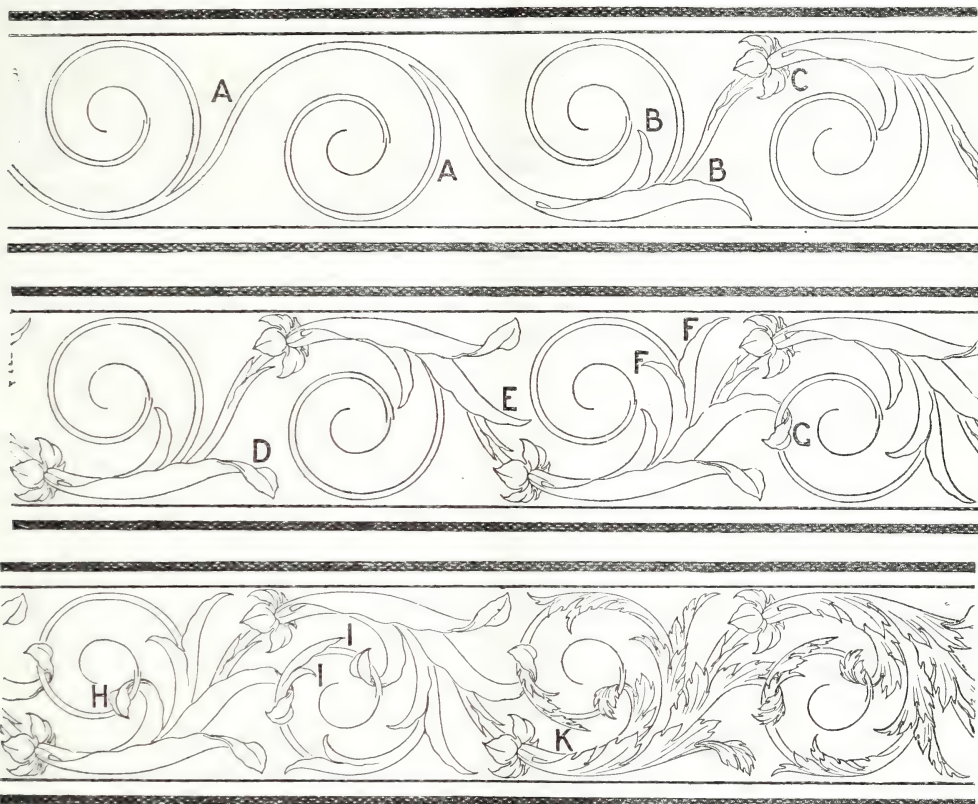
if introduced at the Nodes—a, and c—in fig. 38A, there should be one at the Node—b—, and at all similar positions on the Stem.

CHAPTER VII.—STEM CLOTHING.

§ 62.—DEFINITIONS.

The STEM and BRANCHES are said to be *clothed* when the Sheath-leaves and Stem-calices, mentioned in the last two Chapters, are applied. The Sheath and Calyx may be considered in reference to :—

- (a) The Stem and Branches, *i.e.* the added Interest or Richness, which is treated-of in this Chapter; and
 (b) The Enclosed-space in which the ornament is applied, *i.e.* the Distribution of the details in filling the Interstices between the larger portions, which is treated-of in Chapter XIV.



FIGS. 39, 40, & 41.

A kind of Artificial - ornament, in which Sheath-leaves were not used, was much practised by the German Silver-engravers of the sixteenth century. The Stem, fig. 28, by H. Aldegrever, *circa* 1540, shews very few Sheath-leaves; and they appear to have been applied in a very casual manner, without any regular system. This method generally produces an effect in which the Stems are too *thin*, and the (small) *masses* are confused. It makes Texture, rather than organic Ornament.

§ 63.—STEM-CLOTHING : DEVELOPEMENT.

The GRADUAL ENRICHMENT of the Stem, by the addition of Sheaths and Calices, is

shewn in figs. 39 to 41. These three figures may be joined-together; and thus form one Border, which will shew the gradual Increase of Clothing, from the bare Stem—A—to the full Clothing—K—, as follows:—

- A ...shews the Stem and Branches without clothing, as set-out by the Artist.
 B ...shews the large Primary-sheath, which covers the Node.
 C ...shews the Stem-calyx.
 D ...shews the Reverted-end of Sheath.
 E ...shews the Secondary-sheath (one leaf only), which clothes the continuing Stem.
 F ...shews the Tertiary - sheath, which clothes the issuing Branch.

G ...shews the Reverted-end of Secondary-sheath, which curls - round the Branch, and so gives Connectedness to the composition.

H ...shews a similar Reverted-end of the Inner-leaf of the Primary-sheath, which also curls-round the Branch, and gives more Connectedness.

I ...shews a fourth Sheath, which further clothes the Stem.

Each of these, from—**B**— to —**I**—, is an Additional - portion to the before - existing Design; and, after its introduction, it is continued to the end of the figure.

K ...shews the application of Biserrate-lobation to the Leaf-edge, which imparts the final Richness to the Clothing.

TECHNICALLY: the Connectedness, resulting from the curling-over at—**G** and **H**—, is very useful in Gratings, &c., and also in Stencilling, in which it gives opportunity for the Ties.

CHAPTER VIII.—THE FLOWER.

§ 64.—DEFINITIONS.

The FLOWER is a "terminal-bud" which encloses the arrangements provided for the reproduction of the Plant. In being a *terminating* organ (*i.e.* as there is no stem or leaf growing-out from it) it differs from the Leaf-buds, through which the new Branch grows. The Flower usually consists of two Whorls of Leaves, arranged concentrically round the central organ, which is termed the Pistil.

The CALYX, or outer-whorl, which is so termed because it *covers* and protects the inner-whorl, is generally cup-like in form; and is divided into leaves, termed Sepals.

The SEPAL is a small strong coarse leaf; generally green or dull in colour; and generally conjoined to the others at the base.

The COROLLA or inner-whorl, which is so termed because of its general similarity to a *small Crown*, is composed of a number of leaves termed Petals.

The PETAL is a large fine delicate leaf; bright in colour; and generally distinct, with a narrow stalk-end to each, by which it is attached at the base.

§ 65.—PRINCIPLES FROM NATURE.

The NUMBER and ARRANGEMENT is termed the Inflorescence. There are many varieties in this, between the Single arrangement of the Arum-lily, the Spike - arrangement of the

Hollyhock, and the Clustered-arrangement of the Hemlock; each of which affords valuable suggestions. (See § 67.)

The TYPICAL FORM, as regards both the Plan (or full-face-view) and the Profile (or side-view), is given chiefly by the Petals. The PLAN is generally *circular* in mass-shape; and the Petals are generally *equal* to each-other; and *radial* in position: as in the Rose, Mallow, Aster, &c. Some Flowers are not circular but *bi-axial*, *i.e.* divisible into two reciprocating Halves, *e.g.* the Fox-glove, Laburnum, Pea, &c.; which are termed Papilionaceous, from their resemblance to a *Butterfly*. In CIRCULAR FLOWERS: the Petals of the superior Whorl are arranged *alternately* with the Sepals of the inferior Whorl; so that the end of a Sepal is visible between each two adjacent Petals. The PROFILE is very varied: in the *circular* Flowers, between the Plate-form of the Aster, the Bowl-form of the Ranunculus, the Cup-form of the Tulip, the Cone-form of the Convolvulus, the Trumpet-form of the Daffodil, the Bell-form of the Campanula, the Re-verted-leaf-form of the Iris; and in the *papilionaceous* Flowers, by their characteristic Side-views; all of which afford valuable suggestions in Art. (See § 68.)

The ATTITUDE is very varied in the different plants; but the three which are the most characteristic are: (1) the vertical or Erect-attitude, as in the Geranium; (2) the oblique or Drooping-attitude, as in the Sunflower; and (3) the pendulous or Hanging-attitude, as in the Fuchsia. (See § 69.)

The POSITION, on the Plant, is also varied in the different plants; but the two which are the most characteristic are: (1) the Axillary-position, in which the Flower grows-out in the angle between the Stem and Branch; and (2) the Summit - position, in which the Flower grows at the end of the Stem. In the former, the flowers are distributed at intervals up the Stem. In the latter, there is no flower until the end of the Stem. (See § 70.)

The CONSPICUOUSNESS, necessary to attract the Insects, &c., for the purpose of distributing the Pollen, is attained by largeness of Size and brilliancy of Colour, as well as by the sweetness of Perfume. (See § 71.)

The JUNCTION, of the STALK with the Flower, is also varied in the different Plants; but the three degrees of preparedness which are most characteristic are shewn in: (1) the subtle lines of the Crocus, in which it is difficult from the form (only) to determine where the Stalk ends and the Flower begins; (2) the more-

pronounced lines of the Rosebud, in which the separation, between the Ovary and the enclosed Corolla, is suggested by the contraction of the form; and (3) the well-articulated lines of the Poppy-fruit, where the junction, of the deciduous Calyx with the Stalk, is very distinct. (See § 72.)

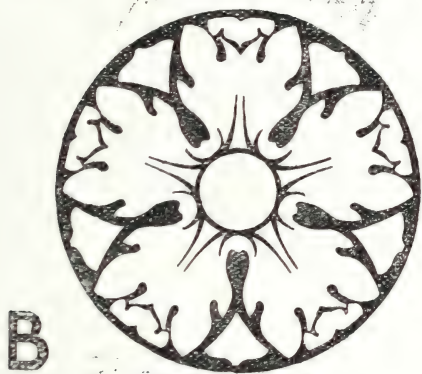
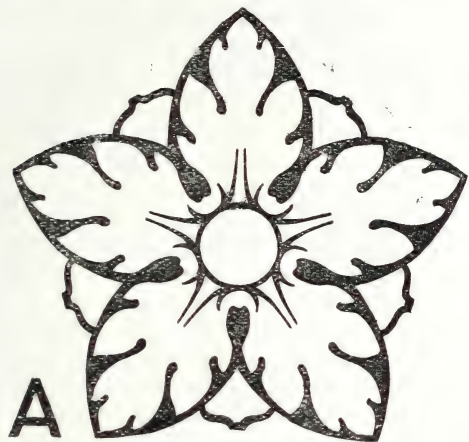


FIG. 42.

§ 66.—THE FLOWER: ROSETTES.

When ISOLATED and shewn FULL-FACE: the Artificial-flower is termed a Rosette. The

number of the Petals varies from three or four to eight or more; an *odd* number being less easy to comprehend at the first glance; and therefore appearing more multitudinous and rich, in effect. The Rosette in fig. 42A contains five. The Petals are *conjoined*, for the purpose of giving connectedness and Breadth. The Sepals are *equal in number* to the Petals; and *alternate* in arrangement; consequently the spaces of the intervening Sinuses (which might cut-up the Flower and lose its Breadth-of-effect) are occupied or filled by the Sepal-ends; as shewn in figs. 43B and 50; and also in the Rosettes in fig. 42. The Leaves are shewn as if *flat* in A; and the Mass-shape is somewhat *pentagonal* in character. If it be desired to have a *circular* Mass-shape: the Sepals should be longer, so that each may touch the circumscribed Circle; or the Petals may be curled-up so that they may not project beyond the Circle of the Sepals, as shewn in fig. 42B. Some Flowers

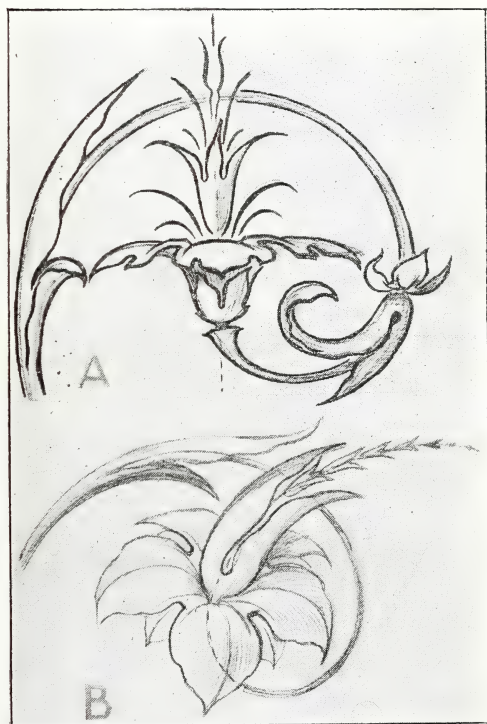


FIG. 43.

in Nature have contorted *Æstivation* (*i.e.* each Petal overlaps its neighbour on one side, and is, overlapped by its neighbour on the other) *e.g.* the Periwinkle. This leads the eye round, and suggests a revolving; and may have given rise to the idea of the Revolving-rosette, shewn in

fig. 42C, which is sometimes introduced, among others, to give Variety. Simple Rosettes are shewn in the Ionic Pilaster-capital of fig. 20; and compound ones (*i.e.* with two Whorls of Leaves) are shewn in the Stele-crest, below. For other details: see § 68.

§ 67.—THE FLOWER: NUMBER.

The NUMBER of FLOWERS varies at the choice of the Artist: in a *vertebrate* Border, he will arrange them in Pairs; in an *undulate* Border he will arrange them singly or in single Groups; in a Panel, he will arrange them to compose with the other important Masses in his Ornament. When only Texture is desired: then the Flowers will be numerous, small, and evenly-distributed. When the composition of Masses is desired: then they will be few, large, and symmetrically-placed.

§ 68.—THE FLOWER: TYPICAL FORMS.

The CIRCULAR Mass-shape, mentioned § 66, and shewn in Figs. 43, 47, 50, 51, &c., is most generally adopted.

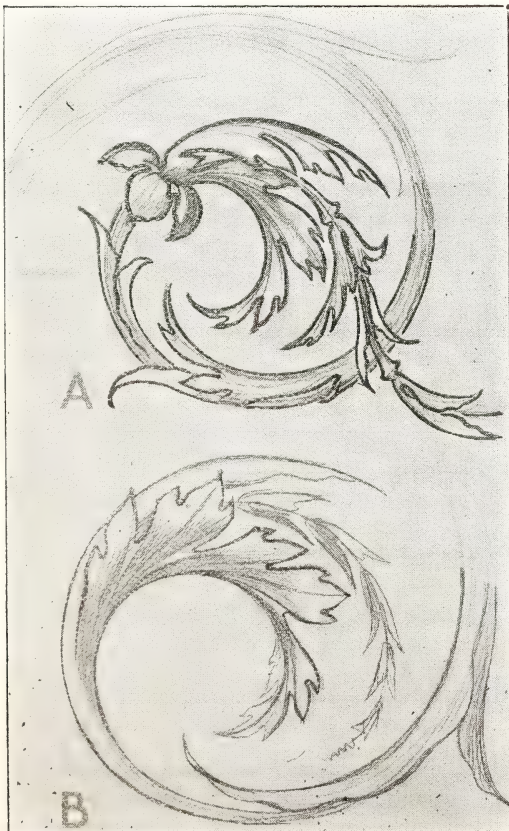


FIG. 44.

The Petal-edge is better when it is *sinuate*, as in figs. 43 and 50, than when it is *serrate*,

as in figs. 42, 47, and 51; because the difference of Leaf-edge gives Variety; and the broader treatment of the Flower gives Importance. If Richness be desired, in a sinuate Petal: it may be given in the Colouring, or the Modelling. The Petals should, as in Nature, be *more beautiful* than the ordinary Leaves; and this is effected by giving to the Flower:—

more Mass when flat;	more Colour when painted;	more Relief when modelled.
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The VENATION is *radial*; and gives pleasing Flow-of-line from the Flower-centre.

The BI-AXIAL form, composed of two Petals, as shewn in Fig. 44, is rarer. It may have been suggested by the papilionaceous Flowers of the order Fabaceæ, or it may be a development from a Sheath. One of the Petals is generally much longer than the other; sometimes the one on the outer-side of the Growth-line is larger; but there is more character when the one on the inner-side is larger, as shewn in fig. 44. The Sepals are shewn as being four in number in 44A. The Calyx is omitted in fig. 44B. The former of these is better because it is more highly articulated, and therefore richer; and also because the reverted Sepals make a Boss which adds to the light-and-shade, and is (like the Stem-calyx) a centre from which the diverging lines of the Petals radiate. The VENATION is *tangential*; and gives pleasing flow-of-line from the Midrib of Petal.

§ 69.—THE FLOWER: ATTITUDE.

The GROWTH-LINES, shewn in fig. 3, govern the Attitude of the Flower. The Vertical Growth-line will obviously give the Erect-attitude; and the Palmate Growth-line will give every variety of attitude. On *horizontal* surfaces the attitudes will be drooping, combined with the full-face-view; and on a *vertical* surface the attitudes will be generally erect, combined with the side-view.

§ 70.—THE FLOWER: POSITION.

The STEM-END is the most usual position for Flowers in Ornament. The Stem is usually spiral; and the Flower is circular, large, and shewn in the Plan, or the Three-quarter-view; as in fig. 50.

The AXIL is occasionally used; and the Flower is small, and shewn in Side-view; as in fig. 49, at B.

IN BORDERS, &c., which are treated with *repeating* ornament: the positions are rigidly fixed by the necessities of the Repeat.

In PANELS, &c., in which the ornament is *not repeated*: the positions are more free; but with a general distribution of more Flowers near the top than near the bottom.

§ 71.—THE FLOWER: CONSPICUOUSNESS.

The BRILLIANT COLOUR of the Natural Flower is generally followed in the Artificial-flower, making it a centre of colour towards



FIG. 45.

which the Leaves, &c., lead-up. In Relief-work: the *brighter* Colour is replaced by the *higher* Projection; and the Flower becomes the Boss or chief Mass amid the Foliage, *e.g.* in the Medici Pilaster, fig. 47.

§ 72.—THE FLOWER: ARTICULATION.

The GROWTH-LINE of the Stem or Stalk, and that of the Flower, are parts of the same curve. This Curve should be simple; and be easily tracible, so that the eye, travelling along the Stalk, receives no check when it comes to the Flower. Hence there should be Unity of Curvature; and the Articulation should be either visible, or inferrible.

The VISIBLE Articulation occurs when the Flower is in side-view; as shewn in fig. 43A for a Circular Flower, and in fig. 44 for Biaxial Flowers.

The INFERRIBLE Articulation occurs when the Flower is in Plan, and the Stem is spiral; as shewn in figs. 43B, 45, 50, &c. The Growth-line is *dotted* in the first two of these; so the eye easily travels-round; and the mind

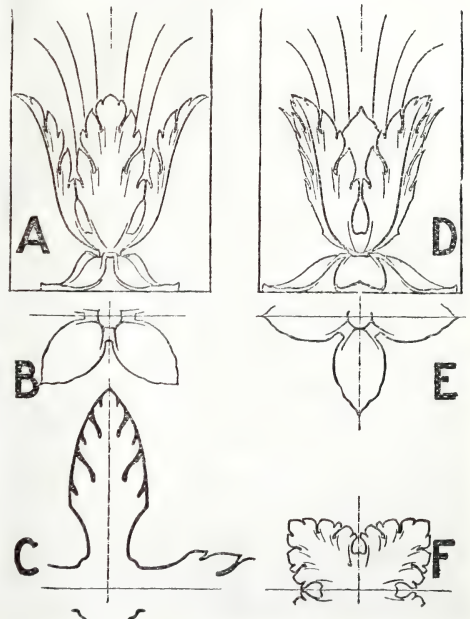


FIG. 46.



FIG. 47.

perceives the Unity of Curvature. Further: from the *visible* portion of the curved Stalk—the remainder, growing towards the centre of the Flower, is inferred. Hence the Stalk should have *so much visible*, and the visible part should have *so much curvature*, as will lead the eye to the Flower-centre: one revolution of the spiral is sufficient for this; as shewn in figs. 47, &c.

The JUNCTION with the Stalk may follow any of the three degrees mentioned in § 65; but the Deciduous-calyx-junction, as shewn in fig. 43A, evinces the most prepared-ness; and gives the most character.

§ 73.—THE FLOWER: VIEW.

The Points-of-view, from which the Flower is seen in Nature, are very varied. In looking at a Shrub, the Observer sees: some flowers in Plan, others in Elevation, others in Back-view, and many others in every degree of Oblique-view. From these: the Ornamentist chooses the first three simpler views; and also of the more complex views, in which Perspective is necessary, he chooses the one known as the Three-quarter-view.

The PLAN is the most severe treatment. When the Flower is *isolated* as a Rosette: then it is appropriately used, as in fig. 29, also in Meyer, plate 146, for a Volute-centre, and as a Panel-centre in plates 154, 160, 161, &c. When the Flower is *connected* with Stems and Leaves, as being an integral part of Foliage: then this severe Plan-view would be too archaic or Egyptian in character. The Plan-view is useful on *horizontal* surfaces, and specially in Floor-diapers (Tiles, Floor-cloth, &c.).

The ELEVATION is almost as severe in treatment. It is occasionally used for Circular Flowers, when a strongly-marked horizontal line is desired, as shewn in fig. 43A; and it is necessary for Two-leaved Flowers (fig. 44), which would not be clear if drawn from any other Point-of-view. The Elevation-view is useful on *vertical* surfaces, and specially in Pilaster-panels (whenever these are decorated with vertebrate ornament, *i.e.* with a central-stem and symmetrical-branches), as shewn in Meyer, plate 131, figs. 1 to 3. The beautiful and suggestive Profiles of Nature, mentioned in § 65, are used here with good effect.

The BACK-VIEW gives pleasant variety. As practice: the student should often draw the back-view of his Ornament, shewing the Calyx and the articulation and curvature of the Stem to each Flower; and he will thus realise the

organic connection between the Parts; and be better able to make his design *clear*. The Back-view is very seldom used in Art, except in double-faced Gratings, and other groundless Ornaments.

The THREE-QUARTER-VIEW is the most elastic and beautiful treatment, as well as the most true. It should be remembered that Relief and Surface-decoration are the representation (on a Ground or Surface) of things which are (or are supposed to be) *solid*; and *seen in perspective*. The Perspective-view, therefore, gives more idea, of the solid reality, to the Spectator, than the Plan-view can; and hence it is more clear; as shewn in figs. 43B, 47, and 50. (The large Flowers, in fig. 51, are shewn with curved midribs to the Petals; but the Disks (or Flower-centres) are concentric with the Flower-mass; and consequently they are not in Perspective.) This Three-quarter-view should be used, always, in Ornament, except where the Position and the Material demand the more severe Plan-view.

TECHNICALLY: The Perspective-drawing of the Flower does not necessarily require a light-and-shadow treatment. The work may be beautifully *drawn* without being so shaded as to disturb the sense of *flatness*, whenever this latter quality is necessary.

[This lecture will be completed in the next Number.]

Miscellaneous.

PAPER MANUFACTURING INDUSTRY AT CANTON.

Paper mills were erected about five years ago by a Chinese company at a cost of 25,000,000 dollars, about twelve miles from Canton. The necessary machinery was imported from England, and erected under the superintendence of two Englishmen, a manager and an engineer, but at present, says Her Majesty's Consul at Canton, both these functions are united in one person—a Scotchman. The native staff consists of 200 Chinese, of whom fifty are women and girls employed at picking rags, separating linen from jute, &c., the remainder being men employed in the care of the machinery or in the actual manufacture of the paper. The mills work day and night as long as any contract is on hand; the company only accepts contracts, and does not manufacture for the market on its own account, consequently when there is no contract the mills are stopped, but as the demand is fairly constant, this is said not often to occur. The average daily out put, working day and night, is 80 piculs (10,640 lbs.), and the average price of the paper is about 10 dollars per picul (21s.

per 133 lbs.). The expenses, at present, average from £57 to £60 per day, and the actual profits are, roughly speaking, about £220 per month. Last year the profits averaged 3,000 dollars (£330 per month), but owing to the increase in the price of coal, the profits have become considerably less. The paper manufactured is principally Chinese writing paper (not the best, which is made by hand), wrapping paper, and fireworks paper. The first is made only of rags, and the two latter of jute, straw, and the bark of the mulberry tree. The chemicals used in the process are imported half from Europe and half from Japan. The water used is filtered once through a bed of cocoanut fibre. Recently, a Canton tobacco merchant, who exports largely to countries where Chinese are living, offered to take a large quantity of wrapping paper, provided a particular water-mark could be made in a certain place. The company are trying to produce the water-mark, and the tobacco merchant says that, if successful, he could employ the mills to the extent of 40,000 dollars per annum. Another tobacco merchant also offered work to the extent of 10,000 dollars per annum.

General Notes.

SANITARY INSTITUTE.—The Council of the Sanitary Institute have arranged for a second course of public lectures on the "Sanitation of Industries and Occupations," to be delivered at the Parkes Museum, Margaret-street, on Thursday evenings, Nov. 1, 8, 15, 22, and 29, at 8 p.m. The titles of the lectures are:—Nov. 1, "Coal Mining," by Simeon Snell, M.R.C.S.; Nov. 8, "Quarrying of various kinds—Granite, Marble, Stone, Slate, Chalk, and Limestone," by Professor C. Le Neve Foster, F.R.S.; Nov. 15, "Workers in Mercury, Phosphorus, and Sulphur," by T. Eustace Hill, M.B.; Nov. 22, "Chlorine and Chrome Compounds," by D. J. O'Neil, M.B.; Nov. 29, "Workers in Copper, Zinc, Brass, and Tin," by R. M. Simon, M.D.Cantab.

MANCHESTER ARTS AND CRAFTS EXHIBITION.—The Art Gallery Committee of the City of Manchester has arranged to hold an Exhibition of contemporary Arts and Crafts, in the rooms of the City Art Gallery, in April next. The committee hope to receive examples of decorative painting, sculpture, and modelled work; wood, stone, and ivory carving; mosaic work; metal work, cast and wrought, and chasing in iron, brass, copper, gold, and silver; pottery and table glass, stained and painted glass; textiles, woven and printed, embroidery, tapestry, and laces; jewellery and other articles of personal ornament and use; clocks and watches; engraving and printing, book decoration and binding, printers' ornaments, illuminated and decorated MSS.; ornamental leather work; wall-papers, and other forms of surface decoration; photography; designs and cartoons for decoration of all kinds; architec-

tural, mechanical, and ship models. Those wishing to exhibit should at once apply to the Curator of the City Art Gallery, Manchester.

THE SWEETMEAT INDUSTRY OF BOMBAY.—The *Rast Gofstar*, the leading Gujarati paper of Bombay, in its issue of the 16th of September, writes:—"Our Anglicised natives like all European sweetmeats, and despise their own; but Sir George Birdwood likes Indian sweetmeats; and his descriptions of them is enough to make the mouth water of those natives who still like them as we [Editor of *R.G.*] do. They are published in the *Journal of the Society of Arts*, and the Doctor, with his well-known learning, gives a most captivating account of every denomination of Bombay sweetmeat known to him, and he knows more than we ever knew ourselves before, giving simple directions for making each, with a relish as if he was sucking them all the time he was inditing their praises. They are all—*barfi*, *halvi*, *ghevar*, and all—delightful to the Doctor-poet; and beside these Indian sweetmeats he is inclined to scoff at the European. The more serious reflection on his eulogium is that, there are now no Englishmen left of the old East India Company's type of Sir George Birdwood, who are able, or care, to exert themselves in such subtle, indirect ways, to influence the natives of this country to love and cherish their indigenous productions, and manufactures, and institutions, *i.e.*, 'to have a good conceit of themselves.'"

MEETINGS FOR THE ENSUING WEEK.

- MONDAY, NOV. 5.**—Farmers' Club, Salisbury-square Hotel, Fleet-street, E.C., 4 p.m. Mr. Rew, "The Report of the Royal Commission on Labour, so far as it relates to the Agricultural Labourer."
Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.
Engineers, Town-hall, Westminster, S.W., 7½ p.m.
Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. Watson Smith, "The Composition and Constitution of certain Alloys, by the late Dr. C. R. Alder Wright." 2. Mr. W. F. Reid, "Note on Oxidised Linseed Oil."
British Architects, 9, Conduit-street, W., 8 p.m. Opening Meeting. Address by the President, Mr. Frank C. Penrose.
- WEDNESDAY, NOV. 7.**—Geological, Burlington-house, W., 8 p.m. 1. Prof. A. H. Green, "Notes on some Recent Sections in the Malvern Hills." 2. Mr. Philip Lake, "The Denbighshire Series of South Denbighshire." 3. Rev. J. F. Blake, "Some Points in the Geology of the Harlech Area."
- THURSDAY, NOV. 8.**—Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. H. D. Wilkinson, "Notes on Electric Tramways in the United States." 2. Messrs. R. W. Blackwell and Philip Dawson, "Electric Traction, with special reference to the Installation of Elevated Conductors."
- FRIDAY, NOV. 9.**—Astronomical, Burlington-house, W., 8 p.m.
Physical, Science Schools, South Kensington, S.W., 5 p.m. 1. Mr. J. Larmor, "The Stationary Light Waves." 2. Prof. H. Young, "Vapour Pressure." 3. Mr. John Burke, "The Luminescence of Glass."

Journal of the Society of Arts.

No. 2,190. VOL. XLII.

FRIDAY, NOVEMBER 9, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.**ARRANGEMENTS FOR THE SESSION.**

The First Meeting of the One Hundred and Forty-first Session of the Society will be held on Wednesday, the 21st November, when the Opening Address will be delivered by MAJOR-GENERAL SIR JOHN DONNELLY, K.C.B., Chairman of the Council. Previous to Christmas there will be four Ordinary Meetings, in addition to the Opening Meeting. The following arrangements have been made :—

NOVEMBER 21.—Opening Address by MAJOR-GENERAL SIR JOHN DONNELLY, K.C.B., Chairman of the Council.

NOVEMBER 28.—“Experiments in Aeronautics.” By HIRAM MAXIM. SIR RICHARD WEBSTER, G.C.M.G., Q.C., M.P., will preside.

DECEMBER 5.—“The Electrical Treatment of Sewage.” By E. HERMITE. SIR DOUGLAS GALTON, K.C.B., F.R.S., will preside.

DECEMBER 12.—“Manufacture of Salt.” By THOMAS WARD.

DECEMBER 19.—“Forestry.” By LIEUT.-GEN. J. MICHAEL, C.S.I.

Papers for meetings after Christmas :—

“The Separation of Aluminium by the Vautin Process.” By PROFESSOR WILLIAM CHANDLER ROBERTS-AUSTEN, C.B., F.R.S.

“The Dressing and Metallurgical Treatment of Nickel Ores.” By A. G. CHARLETON, A.R.S.M.

“The Use of Electricity for Cooking and Heating.” By R. E. CROMPTON, M.I.E.E.

“Tea.” By A. G. STANTON.

“Improvements in Milling Machinery.” By J. HARRISON CARTER.

“Electric Lighting of Ecclesiastical Buildings.” By MAJOR-GENERAL CHARLES E. WEBBER, C.B.

“Russian Armenia.” By DR. A. MARKOFF.

“Madagascar.” By CAPTAIN S. PASFIELD OLIVER.

“Commercial Education Abroad.” By PROFESSOR WILLIAM LAYTON.

“The Lushais, and the Land they Live in.” By CAPTAIN JOHN SHAKESPEAR.

“The Effects of Revenue Legislation on the Agriculture of the Madras Presidency.” By C. KRISHNA MENON.

“The Projected Railways of India, and their Prospects.” By J. W. PARRY, A.M.Inst.C.E.

“Drawing for Process Reproduction.” By GLEESON WHITE.

“Technical Carpet Designing.” By ALEXANDER MILLAR.

INDIAN SECTION.

The meetings of this Section will take place on the following Thursdays, at Half-past Four or Eight o'clock :—

January 17, February 14, March 7, 28, April 25, May 16.

[It has been arranged that three of the meetings will be held at the Imperial Institute.]

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on the following Tuesdays, at Half-past Four or Eight o'clock :—

January 22, February 19, March 5, April 2, 30, May 21.

APPLIED ART SECTION.

The meetings of this Section will take place on the following Tuesday Evenings, at Eight o'clock :—

February 5, 26, March 19, April 23, May 7, 28.

CANTOR LECTURES.

The following courses of Cantor lectures will be delivered on Monday Evenings, at Eight o'clock :—

PROFESSOR VIVIAN B. LEWES, “Modern Developments in Explosives.” Four Lectures.

November 26, December 3, 10, 17.

PROFESSOR SILVANUS P. THOMPSON, D.Sc., F.R.S., “The Arc Light.” Three Lectures. January 14, 21, 28.

ALAN S. COLE, “Means for verifying Ancient Embroideries and Laces.” Three Lectures. February 11, 18, 25.

DR. D. MORRIS, C.M.G., “Commercial Fibres.” Three Lectures. March 18, 25, April 1.

JAMES DOUGLAS, “Recent American methods and appliances employed in the Metallurgy of Copper, Lead, Gold, and Silver.” Four Lectures.

April 22, 29, May 6, 13.

ERNEST HART, D.C.L., "Japanese Art Industries." Two Lectures.

May, 20, 27.

JUVENILE LECTURES.

Two lectures, suitable for a juvenile audience, will be delivered by PROFESSOR C. VERNON BOYS, F.R.S., on "Waves and Ripples," on Wednesday evenings, January 2 and 9, 1895, at 7 p.m.

Proceedings of the Society.

CANTOR LECTURES.

ARTIFICIAL FOLIAGE IN ARCHITECTURE.

By HUGH STANNUS, F.R.I.B.A.

[THE RIGHT OF REPRODUCING THESE LECTURES IS RESERVED.]

Lecture IV.—Delivered 12 March, 1894.

CHAPTER IX.—THE ELONGATE-FLOWER.

§ 74.—DEFINITION.

The CONTINUED GROWTH, from the FLOWER-CENTRE, of Petals forming cups or buds, is termed the Elongate-flower. It is intended to suggest, in figs. 43 and 44, that, after the larger petals are displayed, there is still some un-exhausted vitality which produces the additional growth of smaller Petals, &c.

§ 75.—THE ELONGATE-FLOWER : MOTIVE.

The IDEA might have been adapted from the *side-view* of a Natural Flower, *e.g.* the Daffodil or the Fuchsia. The tubular Perianth, of the former, suggests a succession of cup-like Buds; and the very long Pistil and Stamens of the latter suggest the idea of continued growth on the same axis. It is, however, probable that it was invented by some Artist, who felt that—to finish the Stem at the Flower—was too abrupt; and therefore desired a more-prepared Ending, like the Coda after the Tema, in Music.

§ 76.—THE ELONGATE-FLOWER : MINUTENESS.

The ADDITIONAL-GROWTH should be a grade higher than the Flower. In Nature: there is, apparently, a Scale of increase, in delicate and minute Beauty, from the Trunk, through the Branch, the Leaf, the Calyx, and Corolla, to the Interior and Central-organs. The Artist should strive to imitate this

diminuendo in his work, by making the Elongate-growth more delicate and fine. He may use Serrate-edges, &c.; but he must keep to Buds or Berries, and not use ordinary Leaves or Stems. The ornament, in fig. 45, which shews a Spiral-stem, &c., growing-out from first Flower, is faulty in this particular.

§ 77.—THE ELONGATE-FLOWER : CURVATURE.

CONTINUITY of CURVATURE must always be preserved between the Growth-line of the Stem and the Elongation of the Flower. This is shewn in fig. 43A, in which the Spiral of Stem is joined tangentially with the vertical Growth-line of the Flower; in figs. 43B and 44A, in which the Growth-line is a Loop, like 3F; and in fig. 44B, in which the Elongate-Flower follows the Spiral. It is also tracible, in fig. 53, at—F—.

§ 78.—THE ELONGATE-FLOWER : PROPORTION, AND EXHAUSTION.

The BULK of the ADDITIONAL-GROWTH must be not too large for the Flower. It may be short and swelling, as in the Trajan-frieze, fig. 51; but if long, it should be diminished towards the end, as shewn in figs. 30, 43, 44, and in 50 at F.

The student is advised to draw the Flower with the Elongate-growth on a *straight* Growth-line, as suggested in § 25 and shewn in fig. 11B; and he will then perceive if the foliage be consistent.

§ 79.—THE ELONGATE-FLOWER : APPLICATION.

The ADDITIONAL-GROWTH is useful in Ornamental-design for the following reasons:—

- (a) It prevents an *abrupt ending* of the Stem, at the Flower.
- (b) It gives, by the Diminution, a pleasing *softening* to the Ornament; like the *morendo* passages in Music.
- (c) It *fills* the Interspaces between the larger portions.
- (d) It gives opportunity for *Lines-of-composition*.
- (e) It gives opportunity for *Parallelism* to the Bounding-lines.

TECHNICALLY: by Crossing-over the Stems and other portions of the Ornament, it gives Connectedness, which is useful in several Materials.

CHAPTER X.—THE LEAF-CUP.

§ 80.—DEFINITION.

The GROUP of LEAVES, of a cup-like form, out of which the Stems issue, is termed the Leaf-cup. It consists of two parts: (1) the Cup, which is composed of Sheath-leaves, growing upwards; and (2) the Root-rosette, which is composed of simpler Leaves, lying upon the line that represents the lowest limit of the surface on which the ornament is applied; as shewn in fig. 46.

§ 81.—THE LEAF-CUP: MOTIVE.

The SCALES and BRACTS in Nature appear to have suggested the idea of this portion of Artificial-foliage. It is obvious that—being represented as *organic*, and suggesting the idea of *growing*—Artificial-foliage must have a Start or Commencement, of some kind. The sketch, in fig. 5, shews the Stalk-end of the Branches which grow from the centre towards each side; similarly, in figs. 10 C and 12 B, the Start is a Stalk-end. In the panel by Aldegrevier, fig. 28, the Start is from or out-of the Vase-like object in the centre. In Greek-work: the Start of Organic-foliage is generally from a Leaf-cup, as shewn in the two examples of fig. 29. The Romans adopted this, as seen in the Medici-pilaster, and the Trajan-frieze; and they completed it by the addition of the Root-rosette.

It may be assumed that the Stem pushes its way through the earth into the air and sunshine (as in Nature); and the strong Root-Scales, which protected the tender Shoot, fall-outwards from it. It will be perceived that, as these Root-scales are equal, and lie on the ground in radial positions, they form a Rosette. Further: that the Stem, clothed in its Sheath-leaves, grows-up through this Root-rosette; and that, so soon as they are clear of the confining Earth, they swell out into the Cup-like form, which has been usually adopted.

§ 82.—THE LEAF-CUP: VIEW.

The SIDE-VIEW is the most characteristic, for both the Cup and the Rosette; and it has been always chosen. This does not imply a Side-elevation (because that, as shewn in figs. 46A and 46D, is too mechanical and severe), but a more free Perspective-view (as suggested in § 73, for the Flower).

§ 83.—THE LEAF-CUP: NUMBER AND POSITION OF LEAVES.

An EVEN NUMBER, either two or four, is

adopted in Surface-decoration. When Two LEAVES are used, as shown in Meyer, plate 170, fig. 5: the effect is poor and wanting in Mass; and there is also a technical difficulty in shewing clearly the Stems converging into the Sinus; and further—the Mystery of Nature (which hides the process of multiplying) is ignored. Hence the Greeks introduced the tongue-like Leaf between the pair of spirals from which each Radiating-group springs; as shewn in the bands in Meyer, plate 92, and in the Akroters, *ibid*, plate 105. These Tongue-leaves fill the Sinus, and produce the Mass; they save much Labour with the Radiating-lines; and (like Sheath-leaves, as mentioned in § 54) they hide those things which are Hidden in Nature. When FOUR LEAVES are used, as shewn in fig. 46: they may be disposed with a Leaf in front (46A) which exhibits *three* of the four Leaves; or with a Sinus in front (46D) which exhibits only *two*. The former method, which is that of the Greeks (fig. 29) and the Romans (fig 47), is full and rich in effect; but the latter is open to the same objection as the Two-leaved Cup mentioned above (which is here, however, obviated by the Tongue-leaf).

The Leaves are CONJOINED; and would form a Rosette if laid-out flat. The fig., 46F, shews the whole Cup in Plan.

The above drawings shew the leaves as—not touching each-other; but, when necessary, the central-leaf may overlap, as shewn in the Medici-pilaster (fig. 47); or the whole Leaf-cup may be disposed in contorted-æstivation (as mentioned for the Flower in § 66). The spiral Twisting, resulting from this, produces beautiful Flow-of-line.

§ 84.—THE LEAF-CUP: PROPORTION.

The SIZE of the cup is governed by the quantity of Stems, &c. which issue from it. In Nature: everything is proportional to that which grows-out from it; and there is no waste of material. The mind is, in many cases, so accustomed to admire the infinite wealth of Beauty, that the not less perfect Adaptation and Economy-of-means are sometimes overlooked; but, when it is educated by observation of Natural Construction, it is displeased by the disproportionate and lumpy Masses at the bottom of the Medici-pilaster and the Madeleine-architrave. From the former of these issue (as shewn in fig. 47) two Stems of seven millimetres each, and two Spike-stalks of five millimetres each, making a total sectional area of one-hundred-and-

sixteen square millimetres. The diameter of the Leaf-cup is seventy-five millimetres, having an area of four-thousand-four-hundred-and-seventeen; which is utterly disproportionate; and *appears so* (which is worse, in Art!). If the Lines of these Stems be continued to the Seat-line: some idea of the proper size will be obtained. The Leaf-thickness (as mentioned for the Sheath-leaf in § 49) should be included; and also some space for the Swelling, and the the Divergence-of-growth. When the Leaf-cup is reduced in mass, in accordance with the above Rule: there will be vacant Spaces at the sides. These will be treated-of, as a part of the "Application of Ornament in enclosed Spaces", on a future occasion.

§ 85.—THE LEAF-CUP: CURVATURE.

The MID-RIB of Leaf at each side of Leaf-cup should compose in curvature with the Stems that grow from the cup (as mentioned for the end of the Sheaf-leaf in § 47). Hence the Lines of the Stems, mentioned at end of last section, should be firstly drawn; and the Leaves should be added afterwards. It will be observed, in fig. 29, that the Leaves compose with the Stems better on the Pilaster-capital than on the Stele-crest. If the further-halves of the Side-leaves be shewn (as in fig. 47): then the Midrib should be emphasized, for the purpose of preserving the Flow-of-line, and Clearness.

§ 86.—THE LEAF-CUP: ATTITUDE.

GROWING-UPWARDS should be the general attitude on vertical surfaces; but sometimes (when there is an important Object introduced in the centre of the composition) the Leaf-cup is *reversed*, in order that the Stems may *start downwards* (as shewn in Meyer, plate 167, fig 1), and thus avoid the loss of clearness that would result if the Foliage and the Central-object were confused together.

On HORIZONTAL SURFACES: there is no Rule; and the Leaf-cup may grow *outwards* (*ibid*, plate 154, fig. 7), or *inwards* (*ibid*, plate 161, fig. 4).

§ 87.—THE LEAF-CUP: ROOT-ROSETTE.

This is an IMPORTANT PORTION of Ornament; and, like the upper Leaves, it is arranged in a *Circle*, as before-explained.

THE FORESHORTENING, which results from a side-view of Leaves that lie nearly *flat* upon the ground, causes some difficulty in the Drawing; but this must be faced; and if a Root-scale should fall-over towards the

spectator and be shewn as Central (fig. 46 D): the Leaf-edge, whether sinuate or serrate, must be treated in the same manner as that of the Leaves which are seen in side-view.

THE NUMBER of LEAVES should be not less than four; of which two are shewn when the Cup shews three, as in fig. 46 A (46 B is the plan), and three are shewn when the Cup shews two, as in fig. 46 D (46 E is the plan).

SUBORDINATION to the Cup, should be shewn, inasmuch as the Root-scales are lower in rank than the Leaf-cup. Hence they are often Water-leaves, as shewn in fig. 46.

THE CURVATURE should compose with that of the Line representing the level from which the Foliage starts; as shewn in fig. 46 D, in which the ends of the side-leaves are tangent with the horizontal-line.

THE USE of this appendage is NOT UNIVERSAL. The two Greek examples, in fig. 29, have no Root-rosette. H. Aldegrever, also, has made ornament without it; but his work is not a good model for Organic Articulation. When it is introduced: it should be placed in the Axial-centre of the composition.

§ 88.—THE LEAF-CUP: APPLICATION.

The LEAF-CUP is useful in Ornamental-design for the following reasons:—

- (a) It *clothes* the Group-of-stems at starting, and gives Variety and Interest;
- (b) It gives *mass*, and opportunity for Modelling and Colour;
- (c) It serves as a *centre* from which the diverging branches radiate;
- (d) It gives *attachment*, from the Enclosing-lines (by the manner in which the Root-rosette composes with them), to the Foliage (by the manner in which the Leaf-cup follows the curvature of the Stems).

See also Meyer, plate 131, for application in Pilasters.

TECHNICALLY: the Elasticity in the Shape of the Root-rosette, that permits it to be fitted into any angle, enables the Artist to stop-out the Ground; and hence it is useful in Ornamental-work that is *cast* in any material. When the Ornament and the Enclosing-lines are in the *same piece* of material: then the centre-leaf of the Root-rosette may be made to overlap some of the Lines (or Mouldings) with good effect.

CHAPTER XI.—THE ENDING.

§ 89.—THE ENDING: KIND.

The CULMINATION of the Plant should be (as mentioned of the Elongate-flower, in § 76) a grade higher and more delicate than the parts which have preceded it. For this reason the Stem which grows-out from a Flower is faulty. The Curled-scrolls which occur as Foliage-endings in much work that was executed in the time of François I, King of France, are worse in this particular, as well as being a poverty-stricken substitute. The Animals and Portions-of-animals that grow-out from Foliage, are still worse. Animals have been mixed with Ornament since the Pompejan time; but the Classic method—of the Ornament growing from the Animal (as a Start)—is condoned; while the Renaissance method—of the Animal growing from the Ornament (as if it had been brought-forth)—is condemned.

§ 90.—THE ENDING: TREATMENT.

A REDUCTION, in SIZE and CONSPICUOUSNESS, of the Endings, is advisable in all Ornament, unless it is necessary to reinforce or emphasize the margin. This produces the softness which (as mentioned for the Elongate-flower, in § 79) is pleasing.

CHAPTER XII.—THE VERMICULATE TENDRIL.

§ 91.—DEFINITION.

The SMALL TENDRIL that intertwines with the larger Stems is termed Vermiculate from its resemblance to the wriggling of *small Worms*.

§ 92.—THE VERMICULATE-TENDRIL: MOTIVE.

The BRUSH-FLOURISHES, made by the Greek Pottery-painters to fill the Interspaces between the larger curves of their ornament, are the first Instances of this Motive; and it was afterwards systematised and made organic, with Leaves, &c., by the Romans.

The TWINING PLANTS, *e.g.* the Vine, Ivy, Convolvulus, Hop, Honeysuckle, &c., may afford suggestions to Modern students. The Honeysuckle in the Hedge—as at intervals it comes to the surface, variegates it, and then turns inwards, to appear again in another place—is suggestive, both in the colour and in the contrast between its much-curving stems and the stiffer ones of the Thorn. Thus this Combination, of the characteristic Stem-

growth of different Plants, is analogous to that of the Leaf-venation, as mentioned in § 40.

§ 93.—THE VERMICULATE-TENDRIL: ORIGIN.

The PLACE of BRANCHING from the Stem is hidden under the primary Sheath-leaves; and the Tendril appears to issue from them. There are three Positions, as shewn in fig. 38, from which it may issue:—

e...The Axillary-position;

f...The External-position; and

d...The Internal-position.

The AXILLARY-position is a very difficult one, because there is not sufficient space, between the two larger curves, for the Vermiculate-curve to commence, without a confusing of their lines, and a consequent loss of Clearness. The EXTERNAL-position is



FIG. 48.

almost as difficult. In this: it is necessary that the Tendril should make a divergent curve of *as large* a radius as the main Stem, as shewn in fig. 48B, before it is sufficiently clear of it to enable the direction of the Curvature to be changed in order that it may be brought across the Stem. The Trajan-frieze, fig. 51, follows this position; and the commencing-curve will be seen to be very lame and unpleasing. The INTERNAL-position is the easiest to treat; and the best in effect.

In this: the Tendril diverges in a *small* radius, as shewn in fig. 48A, and can be quickly turned across the Stem. The Curves must be of *small* radius and *quickly-changing* Direction; in order that they may not attract the Eye, and cause it to run off the Stem-curves. The Tendrils should not appear to compete with the Stems, in any manner; in order that they may be Subordinate.

§ 94.—THE VERMICULATE-TENDRIL: COMPARISON WITH THE BRANCH.

The DIFFERENCES, between the Branch and the Tendril, are shewn in the two columns below, of which the L.H. one refers to the Branch, and the R.H. one to the Vermiculate-tendril:—

(The Branch)	(The Vermiculate-tendril)
FUNCTION:	
To carry-on the Growth of the Ornament.	To fill the Interspaces between the larger Stems, &c.
To give Flow-of-line, and lead the eye along pleasant curves.	To give Texture, and avoid anything which attracts the eye.

SIZE:

Large, and bulky.	Small, and thin.
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CHARACTERISTICS:

Severity.	Playfulness.
The Branch must be clearly tracible.	The Tendril may give Mystery.

LINE OF COMPOSITION:

Geometrical.	Indeterminate.
Spiral, or Straight.	Vermiculate.

RAMIFICATION:

May divide into smaller Branches.	Should not ramify.
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CLOTHING:

Sheath-leaves, which are proportional to the Stem.	Stalk-leaves, which are large in proportion to the Tendril.
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§ 94.—THE VERMICULATE-TENDRIL: APPLICATION.

The VERMICULATE-tendril is useful in Ornamental - design for the following reasons:—

- (a) It gives *value* to the larger and simpler Curves, by the smallness and changefulness of its own;

- (b) It *fills* Interspaces, which might otherwise be difficult to treat;
 (c) It gives *Texture* where that is required;
 (d) It *connects* the different parts together; and
 (e) It gives opportunity for *Parallelism*.

CONSISTENCY should govern the use: there is much good Ornament without any Tendril; and it need not be introduced at all; but if used at one position, it should be used at all similar positions on the Stem.

TECHNICALLY: the Connectedness produced by Tendrils is of great value in Perforated and Flat work of all kinds and materials.

CHAPTER XIII.—THE INTERSPACE.

§ 95.—DEFINITIONS.

The UNCOVERED GROUND, between the larger portions of the Ornament, or between them and the enclosing lines, is termed the Interspace. It is impossible to give Examples of all which may occur; but a typical one—an Undulate - stem with Spiral - branches, in a Border—is given. In fig. 39 two spaces, marked — A, A—are situated between the Stem and the Branch; and are therefore Axillary - spaces. They occur alternately along the upper and lower margins; and are Trianguloid in Shape. These Axillary-trianguloids are the Interspaces which are difficult to treat. The other Interspaces, along the margin, are easily filled by Sheath-leaves, as shewn in fig. 41, H to K.

§ 96.—THE INTERSPACE: TREATMENT.

The VARIOUS EXPEDIENTS, for treating the Interspaces, are shewn in figs. 49, and 50. These two figures may be joined-together; and thus form one Border which exhibits the expedients, from the empty Interspace — A—to the most pleasing treatment — F—, as follows:—

- A...shews the Interspace, bare and empty.
 B...shews an opening Axillary-bud or Flower in Elevation. This fills the Interspace completely; and is rather severe in character.
 C...shews a Sheath-leaf of the Spiral-branch, with a reverted-end. [This Leaf should be larger in bulk, as shewn at — F—in fig. 40.]
 D...shews a smaller Spiral-branch intertwining with the Stem. It is rather wanting in Balance.

E...shews a Vermicu'ate-tendrill; which is a pleasant treatment.

F...shews an Elongate-flower; also a pleasant treatment.

B



A

C

FIG. 49.



E

FIG. 50.

There are other experiments which have been tried, *e.g.* :—

(*g*) The Sprays of nondescript foliage, introduced as growing-out from the Sheaths, as shewn in fig. 31, by the Artist, Salembier, before mentioned; which is a confession of his inability to use Ornament.

(*h*) The Animals, introduced as flying, walking, or perched, as shewn in fig. 47, by the Romans. These should be *small*, *e.g.*, the Sparrow, Mouse, Lizard, &c., in order that they may be in-Scale with the Foliage.

The Treatments marked—E, and F—are the most pleasing.

TECHNICALLY:—B—is suitable for a close Ground-less Border;—C, or D—for Wrought-iron; and—E, or F—for Relief in carving or plaster.

CHAPTER XIV.—ARTIFICIAL - FOLIAGE : EMPLOYMENT.

§ 97.—THE TWO EMPLOYMENTS.

The ARTIFICIAL-LEAF is either :—

- (*a*) A Surface-leaf, *i.e.* attached to a Ground-surface, for the whole or nearly the whole of the Leaf.
- (*b*) A Solid-leaf, *i.e.* employed on Solids, but not attached to any Ground-surface except for some portion at the Leaf-base. This employment of the Leaf originated at Korinth; and it is therefore termed the Korinthian-leaf.

The Differences, between these, are shewn in the two columns below, of which the L.H. one refers to the Surface-leaf, and the R.H. one to the Korinthian-leaf.

(The Surface-leaf) (The Korinthian-leaf).

FUNCTION :

Is enclosed by other features, *i.e.* is passive.

Is an encloser of other features, *i.e.* is active.

SIZE :

Is smaller, and more delicate.

Is larger, and bolder.

CHARACTERISTICS :

Is playful.

Is severe.

POINT-OF-VIEW :

Is seen inside view, except the Leaf-cup.

Is seen in back or front view.

Generally half the Leaf, sheathing a Stem.

Generally the whole Leaf, with Architectural Mouldings.

GROUND-SURFACE :

Is always attached to the Ground (except when the ornament is perforated, *i.e.* groundless).

Does not require a Ground ; and is often used without one.

(The Surface-leaf) (The Korinthian-leaf).

FORM OF THE OBJECT :

Is not affected by the Leaf.

Is generally produced by the form of Leaf.

RELIEF :

Is in low-relief, or flat.

Is in high-relief, and often in complete relief.

The whole of Leaf is attached.

The Leaf-end curls away from the object to which the Leaf is applied.

APPLICATION :

Is used on decorative Features.

Is used on functional Features.

Is internal, on Surfaces of: (1) Texture, *e.g.* Diapers (§ 98); (2) Enclosure, *e.g.* Panels (§ 99); and (3) Continuance, *e.g.* Bands, Borders, and Friezes (§ 100).

Is external, on Solids of: (1) Revolution, *e.g.* Vases (§ 102), Capitals, &c. (§ 105); (2) Construction, *e.g.* Consoles (§ 106); and (3) Continuance, *e.g.* Mouldings (§ 107).



FIG. 51.

§ 98.—THE SURFACE-LEAF: EMPLOYMENT IN DIAPERS.

DIAPERS are used for decoration : in Architecture, *i.e.* on surfaces which are : (1) stable,

and (2) displayed ; and in Textiles, *i.e.* on surfaces which are : (1) moveable, and (2) folded. In Architectural-diapers: the Artificial Flower, Leaf, &c., may be used ; but it is difficult to utilise the Spiral-stems, as their severe geo-

metrical character is too pronounced and attracts the eye too much for the quietness of Texture. In Textile-diapers: Artificial-foliage is unsuitable; and Natural-foliage, or the Persian Traditional versions of it, are the proper kinds to employ.

§ 99.—THE SURFACE-LEAF: EMPLOYMENT IN PANELS.

The PANEL, being the least useful of all the parts in Decoration, is chosen for the display of the most varied treatments; and consequently all the Organs of Artificial-foliage may be employed.

§ 100.—THE SURFACE-LEAF: EMPLOYMENT IN BANDS, &C.

The BAND is a functional Feature; and the decoration is therefore severe in character. The Artificial-leaf, with an Undulate-stem, may be used. The Longitudinal-growth is the most suitable; and a succession of Leaf-buds, may be arranged, as shewn in fig. 52. The Tongue-

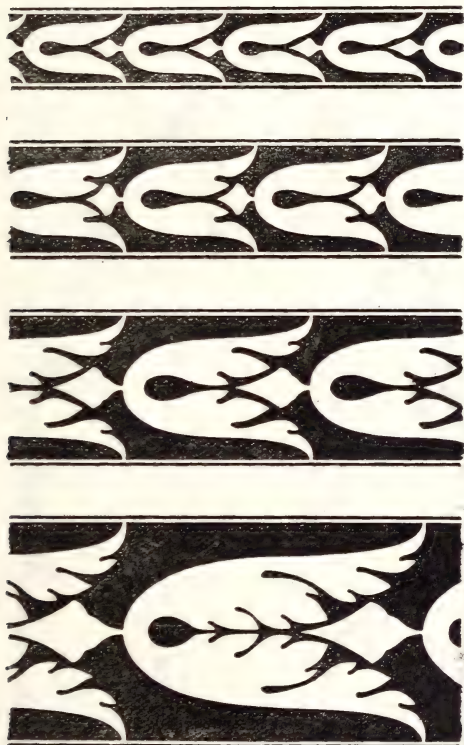


FIG. 52.

leaf (mentioned for the Leaf-cup, in § 83) is used. The Number of the Teeth, in each Leaf, is increased, as shewn, to suit the Increase-in-height of the Band; or, if all the Bands be of equal breadth, the Increase-in-detail will suit the Fineness-of-grain of different Materials (as mentioned for the Lobe-leaf, in § 36).

The BORDER, being less functional, is a little more free in the selection of Elements and their Treatment. Flowers and Buds may be used; and, as Connectedness is not necessary, the Flowers may be isolated as Rosettes.

The FRIEZE is similar to the Panel in treatment.



FIG. 53.

§ 101.—THE KORINTHIAN-LEAF: DEVELOPEMENT.

The city of KORINTH was famous for its Brass in early times. Kallimachos, a Metal-worker, *circa* 440 B.C., who made the golden Lamp for the Temple at Athens, probably made a Lamp-stand for it, which would be decorated with Leaves, cast in Korinthian-brass, and fastened round the upper part. These Lamp-stands were often similar in design to the Pedestals for Statuettes. A Vase-painting shews a Pedestal with an Ionic capital; and it is probable that the solitary "Korinthian" capital found at Bassai was not used architecturally to support the Architrave, but only as the top member of a Pedestal for a votive Statute. In the year 396 B.C. Skopas is said to have used foliated capitals on some columns in the interior of the Temple at Tegea; and at length in the year 335 B.C. it was used externally as supporting the Archi-

trave, in the Monument of Lusikrates. This short statement tends to suggest that the Foliated - capital was used in Metal, on Pedestals, before it was adopted by Architects in Marble, for Columns. The name (like "Damask" instead of "Damaskus-cloth") is a shortening from "Corinthian - brass": Pliny mentions that a Portico in Rome was called "Corinthian" because the capitals were of Brass; and at Baalbek some of the Capitals have the Bell plain, as if the Leaves, &c., were of metal and added subsequently to the erecting. The *metallic* character, of the Capital, is another strong argument in favour of the above suggestion:

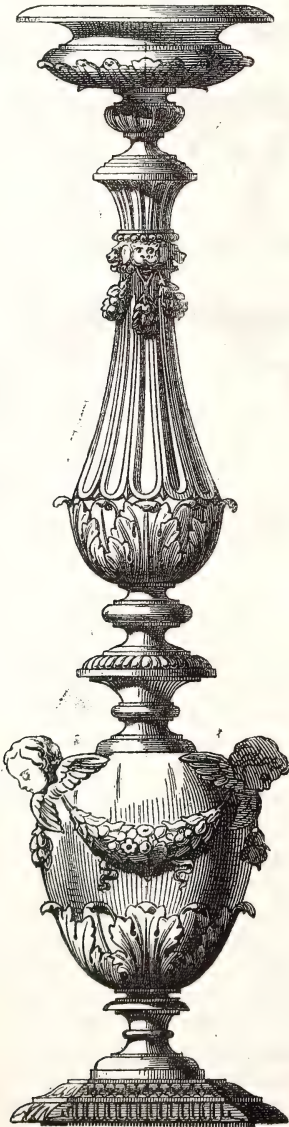


FIG. 54.

§ 102.—THE KORINTHIAN-LEAF: EMPLOYMENT IN VASE-STANDS.

This FIRST EMPLOYMENT has been retained: the Roman marble Lamp - stand (Meyer, plate 121, fig. 2) is a reproduction from a bronze original, in which each Leaf was cast separately, and attached by Rivets; and in the Renaissance example (fig. 54, *seq*) the original wax Model for the convex portions would be built-up in separate Leaves.

§ 103.—THE KORINTHIAN-LEAF: TWO SURFACES.

The INNER-FACE of the Leaf-end is seen in each of the last two examples; and the student should realise the difference between these two Surfaces.

In NATURE: there is much difference between the Outer and Inner faces. The one that is first seen, as the leaf is enfolded in the Leaf-bud, is the Outer-surface; which, after the leaf expands and falls-over, becomes the Under-surface. Similarly: the Inner-surface

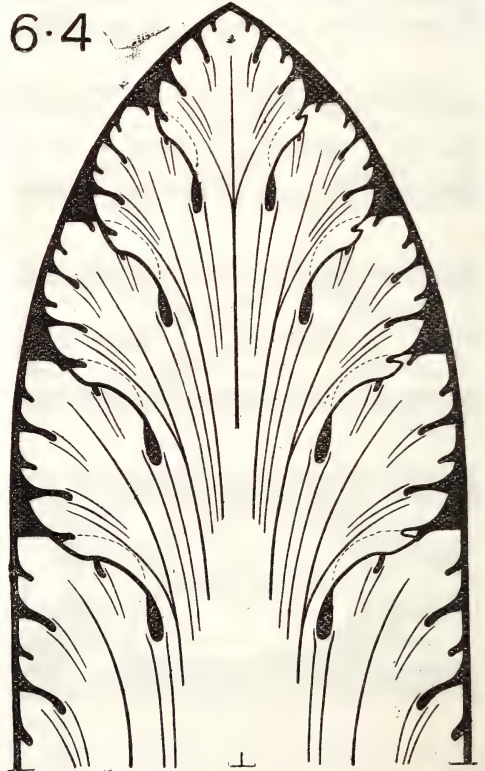


FIG. 55.

becomes the Upper-surface. The OUTER and UNDER-SURFACE is, generally, roughish and often hairy in texture, light and greyish in

colour, and much interrupted by the projecting Sap-vessels. These serve the additional purpose of stiffening and supporting the Blade of the leaf; and hence are termed Ribs; and they ramify in arrangements analogous to those of the Branches. The INNER and UPPER-SURFACE is, generally, smooth and shiny in texture, strong in colour, and much divided by minute Channels, corresponding in position to the Ribs. These are termed Veins.

This DIFFERENCE may be adopted in Art; in which case the Ribs (in the centre of each Lobe) will be on the Outer-surface, as shewn in figs. 24 to 26; and the Veins will be on the Inner-surface, as shewn in figs. 55, and 56.

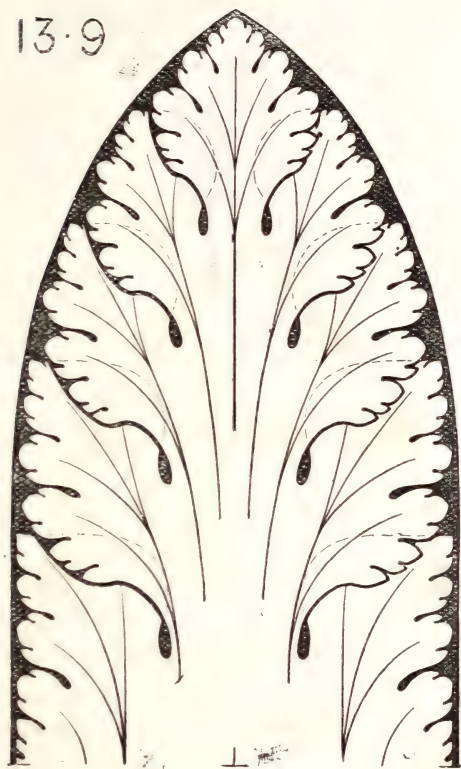


FIG. 56.

The Pipes will then be relegated to the Inner-surface, as shewn in fig. 55 (but not in fig. 56); and thus, when the Inner-surface is seen, they will give Radiation, like the Ribs in the Outer-surface (*cf.* fig. 14). The Overlapping of the Lobes is exactly the converse of that mentioned in § 39, and shewn in figs. 24 to 26. [The Roman treatment, shewn in fig. 57, (invented about two thousand years ago, and since used without alteration) exhibits a strong Rib in the Central-lobe but none in

any Side-lobe. Some more firm lines were required to support the central one; and hence the Pipes were emphasized. These Pipes are not a *part* of any Leaf, but are merely casual Wrinkles of the Lamina, which is folded because of the rigidity of the Ribs, that have been *ignored* by the Roman Artist.] There is no great necessity to make this Difference, when employing the ordinary Sheath-leaf on Surfaces; so it was not mentioned in the former part of this Treatise. The author suggests the above Treatment: there has not been opportunity or leisure to make the experiment in a large Capital; and if any one should, after reading this, be incited to do so: he is requested to communicate, either before or during the experiment.

§ 104.—THE KORINTHIAN-LEAF: LEAF-EDGE.

Much DIFFERENCE in LEAF-EDGE exists between the Surface-leaves of the Medici-pilaster (fig. 47) and Trajan-frieze (fig. 51) on the one hand, and the Solid-leaves of the Korinthian-capital (fig. 57) on the other. The former, termed Lobate-biserrate, was treated of in §§ 33 to 41; and shewn in figs. 14 to 56. The latter, termed Lobate-serrate, was mentioned in § 26, and shewn in fig. 13B. The word — “Acanthus” having unfortunately been used by a Roman writer named Vitruvius, *circa* A.D. 10; and these varying kinds of Leaf-edge having to be accounted for: the theorists named the former — “Acanthus Mollis”, and the latter — “Acanthus Spinosus”. The French theorists, with no sense of the incongruous, have named them — “the Parsley Acanthus,” and — “the Olive Acanthus”! The SURFACE-leaf is more complicate and multifarious in detail, because it is employed on surfaces which are: (1) large in size; (2) uniform in direction and therefore equal in lighting; and (3) generally nearer to the eye. The KORINTHIAN-leaf is employed on solids which are: (1) smaller proportionally to the Leaf; (2) circular in plan, and therefore receding from the Light; and (3) generally farther from the spectator. It is moreover arranged in a complicate manner round the Capital; and in these trying conditions—of varying Light, complicate Arrangement, and great Distance—*Simplicity* is required.

In the COMPOSITE ORDER: the more complicate Leaf-edge of the Surface-leaf has been used. A version of it, as arranged by Albert tolli, is shewn in fig. 58; but this is too rich

and complicated for a Capital; and moreover the whole Order has not the consistent character of the Korinthian, and it may be disregarded until it has been systematised.

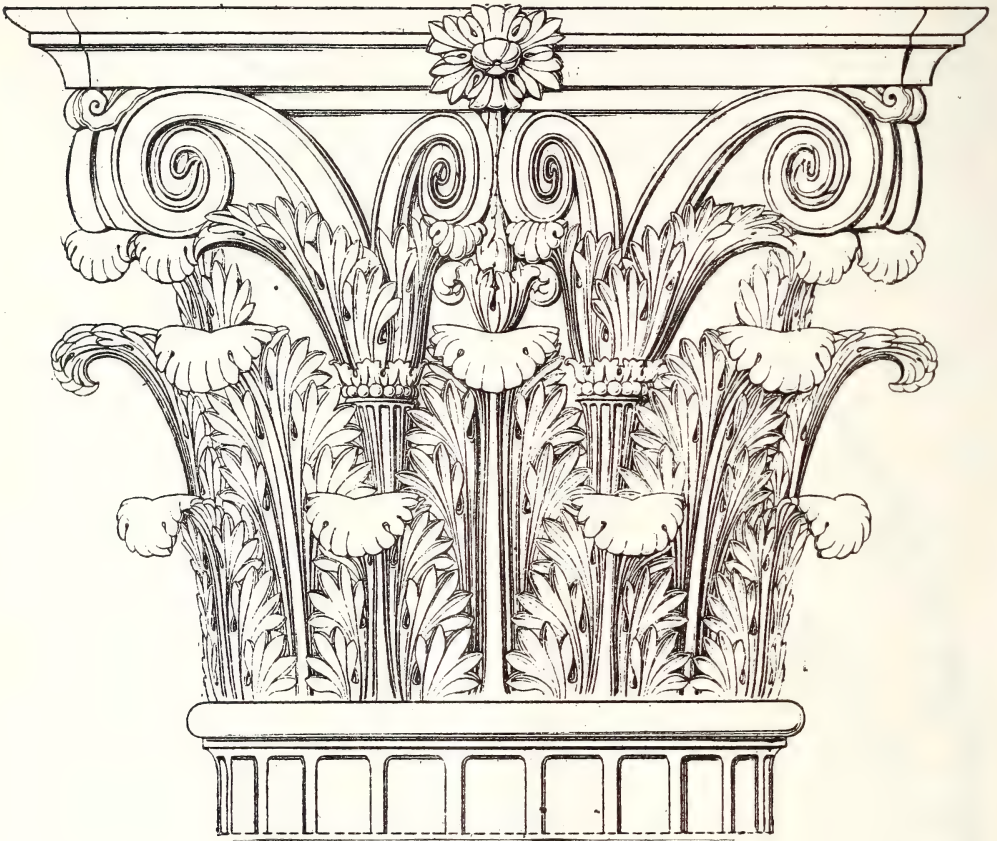


FIG. 57.

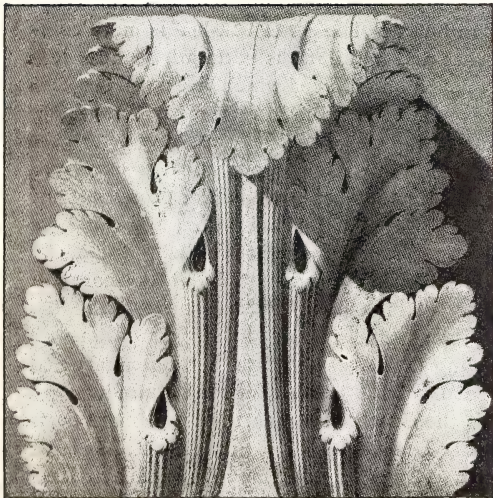


FIG. 58.

§ 105.—THE KORINTHIAN-LEAF: EMPLOYMENT IN CAPITALS.

TO DECORATE the CAPITAL of a Column—is the highest Employment, but also the severest Test of the Leaf.

The OUTER SURFACE of the Leaf is used; evincing in this an analogy with the treatment of the Lotus-capitals by the Egyptian Architects.

The necessary SIMPLICITY of Leaf-edge has been already mentioned. The author would suggest further: that the lower Leaves should have sinuate edges, as if Sepals (see § 106).

The RIGIDITY of expression, necessary in a support, is obtained by: (1) the Verticality of the Ribs at their commencement (as mentioned in § 40, and shewn in fig. 18); and (2) their Massing in a Group at the Midrib (*ibid*),

The BREADTH is obtained by : (1) keeping the Ribs flat and flush with each other, so that a hand passed over would touch all of them ; (2) conjoining the Ribs near the Seat-line ; and (3) conjoining the Leaves, arranging the Sinus a short distance above the Seat-line. This last treatment was not adopted, because in the early examples the brass Leaves were applied separately, and rivetted-on to the stone Bell ; and the tradition has survived ; but it is a great improvement in Breadth-of-effect. In the Wellington Monument : Stevens has conjoined the edges of lower Leaves to the Midrib of upper Leaves ; with good effect.

The UNITY, between the Capital and Shaft, that makes them parts of one functional Whole, is obtained by the following methods of treatment. The CYLINDRICAL SURFACE, at the commencement of the concave profile of the capital, should be the same diameter as the upper-end of the shaft. The Flow-of-line, from the Shaft upwards, is thus not disturbed ; and this will produce Unity of Line. The CARVING of the leaf, at the lower end nearest to the Fluting of the Shaft, should be (like the Flutes) cut-in from a smooth face ; leaving the Ribs and some portion of the Leaf-margins flush with the Profile-surface. At the upper end of Leaf : the Lobes will be hollowed-out in fine broad shadows ; but at the lower ends,

this more severe carving produces Unity of Treatment. The VERTICALITY of the Ribs, being juxtaposed to the vertical Flutes, produces Unity of Character. The author suggested, that greater Sympathy should be evinced between the Shaft and Capital, more than a dozen years ago ; but has seen no result.

The PROPORTION of the LEAF to the Capital has been long settled by the arrangement of having eight Leaves in each Row. If the lower-diameter of the Shaft be divided into 60 minutes ; and the upper-diameter be 50 : then $\frac{50 \times 3.1416}{8} = 19.635$; and the BREADTH of the Leaf is $17\frac{1}{2}$ minutes. If the lower-diameter be divided into 36 minutes : then $\frac{30 \times 3.1416}{8} = 11.781$; and the breadth of Leaf is $10\frac{1}{2}$ minutes. The Breadth is thus $\frac{7}{8}$ of the lower-diameter. This leaves a small space for the Sinus. The HEIGHT is taken at $\frac{1}{2}$ of the lower-diameter. The division into 60 is the more convenient ; and has been followed in the Drawings.

§ 106.—THE KORINTHIAN-LEAF: EMPLOYMENT IN CONSOLES, &c.

On the curved FACE or EDGE, of a Console or Bracket : this Leaf is generally employed. These are, like the Capital, *supporting* Features ; and hence the strongly marked outer-surface is the more appropriate. In fig.

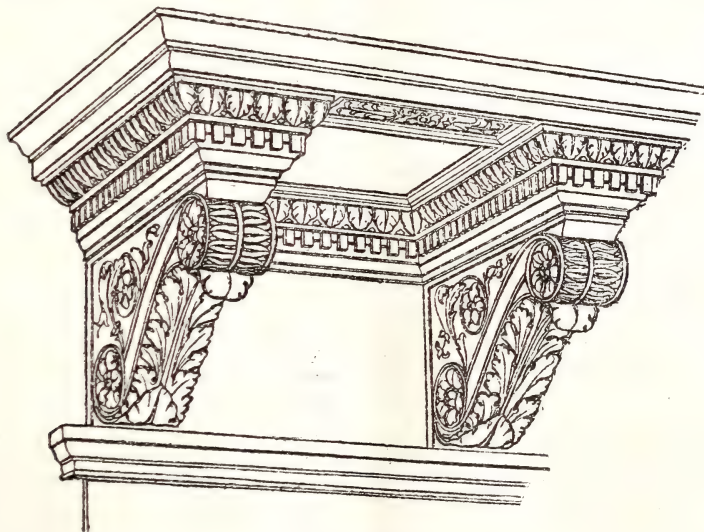


FIG. 59.

59 : the decorative value is seen. The Water-leaf, at the lower end, suggests the Sepal ; and, by its Breadth-of-surface, acts like a

Modulating-chord between the Richness of the upper Leaf and the Simplicity of the lower Mouldings.

The MODILLIONS, which support the Corona in the Korinthian Cornice, are treated with a Leaf on the face, which brings them into keeping with the Capital; and shews logical Unity.

On TRIPODS, CANDELABRUM-LEGS, &c.: this Leaf is also employed.

The LEAF-END is REVERTED in all of these; and, by its Flow-of-line, it gives pleasant Accentuation in the Mass-form.

§ 107.—THE KORINTHIAN-LEAF: EMPLOYMENT IN MOULDINGS.

In MOULDINGS: the Transverse-growth is the most suitable; and a succession of Leaves, conjoined, as shewn in fig. 53, may be arranged. The introduction of the Tongue-leaf, and the Increase-in-detail, are analogous to those in the Band (§ 100). When the larger Leaves are employed: the Leaf-end is often reverted; and this produces a striking contrast, between the high-light on the Leaf-end and the shadow below. The Moulding is a functional Feature; and the CARVING should be (like that on the lower part of Capital) cut-in from a smooth face; leaving as much as possible of the Profile-surface undisturbed.

§ 108.

This is the first Attempt; so far as the author knows, to shew a "Grammar of Ornament" from Nature. The splendid work, by the late Mr. Owen Jones, is rather a Polyglot Dictionary of Historic Decoration.

A Book, published about forty years ago, entitled "Guide for drawing the Acanthus and every description of ornamental foliage by I. Page", was a good book for its time; and has been much used; but it is somewhat lacking in logical arrangement; and more recent attempts are not better.

The treatment of Mediæval Oriental and Modern Ornament, which are amenable to the Rules, is included in the Historic Course.

The Historic-treatment, the Technical-treatment, and the Application of Ornament in Enclosed Spaces, are postponed to a future opportunity.

The author desires to express his obligation to William Carruthers, Esq. F.R.S., of the Natural History Museum, for much kindly given advice.

Errata:—

Page.	Col.	Line.	From.	To.
885	1st	4	37 to 39	.... 39 to 41
"	"	5	50, 51	.... 49, 50
"	"	8	49	.... 51
886	1st	8	49	.... 51

Page.	Col.	Line.	From.	To.
886	1st	35	25 to 27	.... 24 to 26
"	"	"	54 to 60	.... 55 to 58
"	"	"	31 delete	....
"	"	37	41A	.... 38A
887	2nd	25	49	.... 51
888	2nd	8	49	.... 51
910	1st	43	60	.... 59
913	2nd	27	60	.... 59
914	2nd	14	59	.... 58

Miscellaneous.

THE DEVELOPMENT OF RUSSIAN RAILWAYS.

During the past year the activity of the Minister of Public Ways and Communications was, on European Russia, mostly directed to the improvement of the existing railway system, and exercised in the matter of modification of rates of carriage, administration, &c., and to the purchase of private lines of railway on behalf of the Crown, with the object of diminishing the burden imposed on the finances of the country by the payment of the guaranteed minimum interest on these railways, the management of which was generally detrimental to the interests of the Crown. Her Majesty's Consul-General at St. Petersburg says that, in the course of the year 1893, the Government took over the Moscow-Kursk Railway, 272 verstes in length (341 miles); the Orenburg line, 508 verstes (372 miles); the Donetsk, 667 verstes (444 miles); and the Baltic, 568 verstes (379 miles). During the present year of 1894, the Government have acquired the Nicholas Railway, with the Putiloff branch, 630 verstes (420 miles); the St. Petersburg-Warsaw line, 1,207 verstes (804 miles); the Moscow Nijni, 426 verstes (284 miles); the Mitau line, 127 verstes (185 miles); and the Riga-Dunaburg line, 204 verstes (136 miles). Moreover, negotiations are now pending for the purchase by the Crown of the South-Western system of Russian railways. On the other hand, the Government ceded to the South-Eastern Company the Oral-Griazi line, 289 verstes (193 miles), and the Livna Railway, 57 verstes (38 miles). By January 1st, 1894, the total length of the railway lines belonging to the Government, exclusive of the Trans-Caspian and Ussuri lines, amounted to 14,642 verstes (9,761 miles), while the length of private railways, including the Moscow Kazan line, extended over 13,399 verstes (8,933 miles). The whole railway system was not much extended during the past year. A new line from Riazan to Kazan was opened in December last, and the Kursk Veronesh Railway was nearly completed. The newly-established South-Eastern Russian Railway Company has obtained permission for the construction of the following lines:—From Balakova to Kharkoff, a distance of about 600 verstes

(400 miles); from Kharkoff to one of the stations of the Kursk-Kharkoff or Donetz Railway; and from the latter railway to Kalatch, in the district of Bogucharsk, a distance of 90 verstes (60 miles), and some small branches. The Riazan-Ural Railway Company has been allowed to construct a branch from Bogoyavlensk Station to Sosnovky village. The Eupatoria Railway Company will build a branch from Biyuk-Oular Station of the Lozovo-Sebastopol Railway to Eupatoria, with a branch to the port. Lastly, the Vladikavkay Railway Company has received power to construct a branch from the Kavkazki Station to Stavropol, over a distance of 127 verstes (84 miles). The gross receipts per verste, in 1893, of the various State railways were as follows:—Baskunchak line, 5,214 roubles; Warsaw-Terespol, 7,569 roubles; Catherine, 13,171 roubles; Trans-Caucasus, 19,543 roubles; Lebau-Romny—Romny section, 9,287 roubles, and Krinkov section, 2,153 roubles; Muron, 3,024 roubles; Polessie, 3,993 roubles; Pskov - Riga, 2,921 roubles; Samara-Zlotonst, 2,417 roubles; and the Ural Railway, 6,479 roubles. On the private lines, the gross receipts per verste for the Warsaw-Vienna Railway were 24,070 roubles; Dvinsk - Vitebsk, 10,825 roubles; Ivangorod - Dombrovo, 7,270 roubles; Lodz, 39,904 roubles; Moscow - Kazan, 23,607 roubles; Yaroslav - Kostroma, 12,605 roubles; Yaroslav - Vologda, 4,194 roubles; Vistula, 9,196 roubles; Riga - Dvinsk, 11,302 roubles; Riga-Bolderaa, 7,970 roubles; Tsarskoe Selo, 24,663 roubles; and the Orel Griazi, 9,500 roubles. As regards the Siberian railway, the whole of this line will be completed sooner than was expected. The work on it is being pushed forward, and in order to accelerate its completion, convict labour is to be employed on the central portion of the line. The Ussuri section, extending from Vladivostock to Grayskaya Pristan, is also being actively advanced. A section of this line has already been opened.

CULTIVATION OF GINGER IN JAMAICA.

The Director of the Public Gardens and Plantations in Jamaica has recently drawn up, at the request of the Governor, a report on the ginger crops in the island. It is well known that Jamaica is noted for its ginger, the produce of the island being the finest quality known in the market, and consequently it realises the highest price. Mr. Fawcett's notes on the subject will, therefore, interest those engaged in its culture not only in Jamaica but in other ginger-growing countries. He remarks that the quality of commercial ginger is due chiefly to soil, but also to curing, to the variety, white or blue, and to whether it has been freshly planted a few months before, or has been "ratooning" for one or more years. The soil which produces the very highest quality, realising

perhaps £10 per cwt. in the London market, is the very deep black soil of the virgin forest. To grow ginger under this condition, involves the destruction of large areas of forest.

Magnificent trees, 6 feet in diameter, may be seen in some districts lying rotting on the ground, while the ginger cultivators have gone further to the centre of the island, abandoning the woodlands already cut down. The plan adopted in clearing the forest is for a cultivator to invite two or three of his friends to a "cutting match;" he provides food and drink, and the laborious work of felling trees is carried on merrily and without much expense. Afterwards fire is applied and the place is burnt over. This burning is considered very important, as much so as the virgin soil. Probably its importance is due principally to the deposit of potash and other mineral matters contained in the ashes, but the fire also sweetens the ground, correcting sourness, and, moreover, it destroys insect pests. Some cultivators will grow ginger only in freshly-cleared woodlands, and next year they move on to a new clearing, but although they get in this way very fine ginger, it is at the expense of forest land, which would require a very heavy outlay and, perhaps, a term of a hundred years to restore. Albert Town was, not so long ago, a centre for the cultivation, but it seems that growers have already got as far as 14 miles further inland. Ginger can be, and is, grown in many places, year after year, on the same ground, even for 40 years in succession. At Seaford Town, a German colony, one of the original colonists, an old man of 86 years, is said to have been cultivating ginger and arrowroot in the same place from his youth, he and other colonists have been in the habit of planting a small patch one year, leaving it to "ratoon," as long as it was profitable, then throwing it up or growing other plants, until, after a term of years, they again plant the same patch with ginger. This is an irregular rotation of crops. "Plant ginger," the produce of planting, is of better quality than the ratoons, and the ratoons in each succeeding year are inferior. When the ground is too poor to grow white ginger, then blue ginger, the inferior variety, can be grown.

More depends upon the curing of ginger, considering the crop as a livelihood, than soil. At Seaford Town there was a wet season about two years ago: the people could not dry the ginger in the sun; it mildewed; there was very little sun, and the cultivators suffered some distress. Careful attention to the curing is quite the rule, and badly-cured ginger, that is sometimes brought to the market, is due to wet weather, rather than to want of care.

Though it is difficult to make any recommendations on the subject, the following hints are given, as indicating what points are worthy of consideration by cultivators:—The first is the application of manure. There is a prejudice against its use, some maintaining that it breeds worms, and that there is also a difficulty in getting it in any quantity. It is

probable that those who have not succeeded with manure have used it improperly, by applying it fresh, or not sufficiently mixed with soil. As to obtaining it in quantity, example should be taken from the Chinese labourer, who preserves every particle of matter that can in any way be utilised as manure, not only cattle manure, but decaying matter of any kind, night soil, &c.; even soapy water, left after washing, is most useful. To imitate the formation of forest soil, a pit might be filled with alternate layers of bush and manure; everything in the nature of manure or decaying matter should be thrown in, and a layer of soil directly over the manure would be useful. The pit ought to be lined with clay, to prevent the very valuable part of the liquid of the manure from escaping; and a cover of some kind—for instance, a sheet of corrugated iron—should be fixed in some way over the pit, to keep out rain.

To facilitate curing, and even sometimes to save the crop, the chief storekeeper in a district who buys the ginger might find it advantageous to himself and the people to invest in an American evaporator, and dry the ginger artificially.

It is shown that the export of ginger from Jamaica is on the increase. Thus, in 1891, 10,885 cwts. were exported, of the value of £24,493; in 1892, 16,272 cwts., valued at £40,681; in 1893, 13,632 cwts., valued at £27,264; and in the present year the exports already amount to 14,932 cwts., of the value of £44,796.

General Notes.

MONTE VIDEO.—The Science and Art Department have sent to the Society the prospectuses of a National Exhibition connected with stock-raising and agriculture, which is to be held at Monte Video from the 1st to the 31st of March, 1895. The exhibits, besides live stock and agricultural products, include agricultural machines and appliances, and with regard to these it is to be international, whereas the exhibits in the live stock and agricultural produce classes will be national only. Any person desiring further information on the subject can be supplied with a copy of the prospectus on application to the secretary of the Society.

TECHNICAL EDUCATION.—The Science and Art Department have lately issued a report showing the way in which the money raised under the Customs and Excise Act, 1890, has been disposed of in promoting technical education by the County Councils and other bodies to whom the money was made over. The return states that the total amount expended on technical education during the year 1892–3 in Great Britain was nearly £530,000, and that the amount allocated for the same purpose for the year 1893–4 was close upon £700,000. It should

be understood that this amount does not include the sums devoted by private liberality to this purpose, such, for instance, as the money subscribed by the companies of the City of London. The money dealt with in this report includes only the sums obtained from the Customs and Excise Act, and also the amounts raised by local rates levied under the Technical Instruction Acts. It appears, from the report, that a great majority of the local authorities are applying the whole of the funds provided by the Customs and Excise Act for technical education alone, though, in some cases, only a part of the funds are thus applied, and, in a very few, they are used for the relief of the rates. The return gives very full details as to the way in which the money is expended in each case.

MEETINGS FOR THE ENSUING WEEK.

- MONDAY, NOV. 12.**...Scottish Society of Arts, 117, George-street, Edinburgh, 8 p.m. 1. Mr. S. Z. De Ferranti, "Electrical Developments of the Future, and their Effect upon Every-day Life." 2. The President will deliver the Prizes to the several recipients.
- Surveyors, 12, Great George-street, S.W., 8 p.m. Opening Address by the President, Mr. Thomas Chaffield Clarke.
- Geographical University of London, Burlington-gardens, W., 8½ p.m. Mr. H. H. Johnston, "British Central Africa Protectorate."
- London Institution, Finsbury-circus, E.C., 5 p.m. Prof. W. M. Flinders Petrie, "Primitive Egypt."
- TUESDAY, NOV. 13.**...Civil Engineers, 25, Great George-street, S.W., 8 p.m. Address by Sir Robert Rawlinson, the President, and presentation of Medals, &c., awarded last Session.
- Photographic, 5A, Pall-mall-east, S.W., 8 p.m. Mr. H. Dennis Taylor, "A Simplified Form and Improved Type of Photographic Lens."
- Anthropological, 3, Hanover-square, W., 8½ p.m. Mr. H. Saunderson, "Korea, and its People."
- Colonial Institute, Whitehall-rooms, Whitehall-place, S.W., 8 p.m. Miss Flora L. Shaw, "Colonial Expansion."
- WEDNESDAY, NOV. 14.**...Japan Society, 20, Hanover-square, W., ½ p.m. Mr. E. G. Merton, "The Decoration of Swords and Sword Furniture."
- Patent Agents, 19, Southampton-buildings, W.C., 7½ p.m. 1. To resume the Discussion on Mr. Jensen's Paper. 2. Mr. G. Loubier, "The New German Trade Mark Law of May 12th, 1891." 3. Mr. A. V. Newton, "Industrial Progress in the Arts, and how it may be encouraged or retarded."
- THURSDAY, NOV. 15.**...Linnean, Burlington-house, W., 8 p.m. 1. Mr. Thomas Scott, "A Revision of the British Copepoda belonging to the two Genera, *Bradya* and *Ectinosoma*." 2. Dr. D. Train, "Recent Observations on the Plant yielding Bhang (*Cannabis sativa*)."
- Chemical, Burlington-house, W., 8 p.m. Prof. J. J. Dobbie and A. Lauder, "The Alkaloids of *Corydalis Cara*. I. Corydaline (Part IV.) II. Corybulbine." And other papers.
- London Institution, Finsbury-circus, E.C., 6 p.m. Mr. D. Morris, "Wonder-working Plants."
- FRIDAY, NOV. 16.**...Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. John F. C. Snell, "The Economics of Direct-current Central Stations."

Journal of the Society of Arts.

No. 2,191. VOL. XLII.

FRIDAY, NOVEMBER 16, 1894.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

ARRANGEMENTS FOR THE SESSION.

The First Meeting of the One Hundred and Forty-first Session of the Society will be held on Wednesday, the 21st November, when the Opening Address will be delivered by MAJOR-GENERAL SIR JOHN DONNELLY, K.C.B., Chairman of the Council. Previous to Christmas there will be four Ordinary Meetings, in addition to the Opening Meeting. The following arrangements have been made :—

NOVEMBER 21.—Opening Address by MAJOR-GENERAL SIR JOHN DONNELLY, K.C.B., Chairman of the Council.

NOVEMBER 28.—“Experiments in Aeronautics.” By HIRAM MAXIM. SIR RICHARD WEBSTER, G.C.M.G., Q.C., M.P., will preside.

DECEMBER 5.—“The Electrical Treatment of Sewage.” By E. HERMITE. SIR DOUGLAS GALTON, K.C.B., F.R.S., will preside.

DECEMBER 12.—“Manufacture of Salt.” By THOMAS WARD.

DECEMBER 19.—“Forestry.” By LIEUT.-GEN. J. MICHAEL, C.S.I.

Papers for meetings after Christmas :—

“The Separation of Aluminium by the Vautin Process.” By PROFESSOR WILLIAM CHANDLER ROBERTS-AUSTEN, C.B., F.R.S.

“The Dressing and Metallurgical Treatment of Nickel Ores.” By A. G. CHARLETON, A.R.S.M.
“The Use of Electricity for Cooking and Heating.” By R. E. CROMPTON, M.I.E.E.

“Tea.” By A. G. STANTON.

“Improvements in Milling Machinery.” By J. HARRISON CARTER.

“Electric Lighting of Ecclesiastical Buildings.” By MAJOR-GENERAL CHARLES E. WEBBER, C.B.

“Cyder.” By C. W. RADCLIFFE COOKE, M.P.

“Light Railways.” By W. M. ACWORTH.

“Russian Armenia.” By DR. A. MARKOFF.

“Madagascar.” By CAPTAIN S. PASFIELD OLIVER.

“Commercial Education Abroad.” By PROFESSOR WILLIAM LAYTON.

“The Lushais, and the Land they Live in.” By CAPTAIN JOHN SHAKESPEAR.

“The Effects of Revenue Legislation on the Agriculture of the Madras Presidency.” By C. KRISHNA MENON.

“The Projected Railways of India, and their Prospects.” By J. W. PARRY, A.M.Inst.C.E.

“Drawing for Process Reproduction.” By GLEESON WHITE.

“Technical Carpet Designing.” By ALEXANDER MILLAR.

INDIAN SECTION.

The meetings of this Section will take place on the following Thursdays, at Half-past Four or Eight o'clock :—

December 6, January 17, February 14, March 7, 28, April 25, May 16.

[It has been arranged that three of the meetings will be held at the Imperial Institute.]

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on the following Tuesdays, at Half-past Four or Eight o'clock :—

January 22, February 19, March 5, April 2, 30, May 21.

APPLIED ART SECTION.

The meetings of this Section will take place on the following Tuesday Evenings, at Eight o'clock :—

February 5, 26, March 19, April 23, May 7, 28.

CANTOR LECTURES.

The following courses of Cantor lectures will be delivered on Monday Evenings, at Eight o'clock :—

PROFESSOR VIVIAN B. LEWES, “Modern Developments in Explosives.” Four Lectures.

LECTURE I.—NOVEMBER 26.—*Explosives and Explosions.*—Gunpowder—History—Methods rendered necessary by the growth and changes in the character of the guns employed—Modern powders and the methods by which the desired results are obtained.

LECTURE II.—DECEMBER 3.—*Guncotton.*—The improvements which have taken place in its manufacture since its discovery by Schönbein—English service guncotton, and its manufacture—Nitroglycerine—Dynamite.

LECTURE III.—DECEMBER 10.—*Smokeless Powders*.—The early attempts to utilise guncotton, and the causes of their failure—The smokeless powders of to-day.

LECTURE IV.—DECEMBER 17.—*Blasting Explosives*.—Requirements—Fiery mines—A good safety explosive as great a safeguard as the safety-lamp—Explosives employed—The safety explosives now in use—Roburite, &c.

PROFESSOR SILVANUS P. THOMPSON, D.Sc., F.R.S., "The Arc Light." Three Lectures. January 14, 21, 28.

ALAN S. COLE, "Means for verifying Ancient Embroideries and Laces." Three Lectures. February 11, 18, 25.

DR. D. MORRIS, C.M.G., "Commercial Fibres." Three Lectures. March 18, 25, April 1.

JAMES DOUGLAS, "Recent American methods and appliances employed in the Metallurgy of Copper, Lead, Gold, and Silver." Four Lectures. April 22, 29, May 6, 13.

ERNEST HART, D.C.L., "Japanese Art Industries." Two Lectures. May, 20, 27.

JUVENILE LECTURES.

Two lectures, suitable for a juvenile audience, will be delivered by PROFESSOR C. VERNON BOYS, F.R.S., on "Waves and Ripples," on Wednesday evenings, January 2 and 9, 1895, at 7 p.m.

INDIAN SECTION COMMITTEE.

A meeting of the Committee of the Indian Section was held on Tuesday, 6th November, at 4 p.m. Present:—Sir George Birdwood, K.C.I.E., C.S.I., in the chair; Lionel R. Ashburner, C.S.I., J. Athelstane Baines, C.S.I., Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., M. M. Bhownaggee, C.I.E., Sir George Birdwood, K.C.I.E., C.S.I., Hyde Clarke, Lieut.-General Sir Andrew Clarke, R.E., G.C.M.G., C.B., Sir Charles Malcolm Kennedy, K.C.M.G., C.B., Sir James B. Lyall, G.C.I.E., K.C.S.I., Alexander Rogers, Thomas H. Thornton, C.S.I., D.C.L., Sir Charles Turner, K.C.I.E., Sir Raymond West, K.C.I.E., Sir Alexander Wilson, W. Martin Wood, with Sir Henry Trueman Wood, M.A., Secretary, and S. Digby, Secretary of the Section.

INDIAN SECTION.

The opening meeting of the Indian Section of the Society will be held on Thursday evening, 6th December, when a paper on "Roman and British Systems of Government" will be read by the Hon. W. Lee Warner, C.S.I. This meeting will be held at the Imperial Institute.

Miscellaneous.

PRIZES OF COACH MAKERS' COMPANY.

The Worshipful Company of Coach Makers and Coach-harness Makers of London offer the following prizes for competition among British subjects engaged in the trade of Coachmaking and resident in the United Kingdom of Great Britain and Ireland:—

Competition No. 1.—The following prizes, amounting to £50, are offered for the two best models of an improved four-wheel close cab body, and a single or double Victoria body, with an under-carriage and wheels fitting both bodies, easily and rapidly interchangeable, all to be suitable for public use in the streets of London. The models must be to the scale of two inches to the foot; they are to be accompanied by a working drawing to the same scale, and may be made by one person alone, or by more working jointly. The prize models will become the property of the Company. First prize (given by Mr. G. N. Hooper), £40. Second prize (given by the Worshipful Company), £10.

Competition No. 2.—The following prizes, of which £5 5s. are given by Mr. William Hooper, are offered for competition among members of drawing and technical classes of Great Britain and Ireland. Each competitor to send up three drawings of the side elevation of any sort of carriage. Scale one inch to the foot. The drawings are to be selected from the work of the winter session of 1894-5 by the teacher of the class. From three to fifteen drawings may be sent from a class. Prizes from £1 1s. to £3 3s. will be given for the five best set of three drawings—total £9 9s. In connection with the above, the Company's medal may be given to the teacher of the most successful class, should the drawings to which the prize has been awarded be considered of sufficient merit.

Competition No. 3.—For working drawings of a full-sized single Brougham body, any shape, in distinct outline, not shaded, scale two inches to the foot; side elevation, half back, and half plan looking on the bottom; also a cross section at the door hinge pillars looking back. Drawings to show the framing and joints, on two or more sheets. For apprentices and others under 21 years of age. First prize, the Company's Bronze Medal and £3. Second prize, the Company's Certificate and £2.

Competition No. 4.—For working drawings, scale four inches to the foot, on one piece of paper six feet by three feet, of a single Victoria, any shape (not on a perch under-carriage), the head down, side elevation only. All the drawings to be lightly shaded or tinted in a grey colour to make the whole clearer to the eye. First prize, the Company's Silver Medal and £6. Second prize, the Company's Bronze Medal and £4. Third prize, the Company's Certificate and £2.

Competition No. 5.—The Master of the Company (Mr. William Beriah Brook) offers the following prizes, among former prize winners only, for a fully-coloured design, in perspective, of a square Landau, any mode of suspension, to the scale of one inch to the foot. First prize, £7. Second prize, £3.

Competition No. 6.—For models of a Char-a-Banc body, for public use, in wood only, which may be varnished, but not painted; no under-carriage or steps are required. The models to be to the scale of three inches to the foot. If less than six compete, one prize of £6 will be given to the best. If twelve compete, a second prize of £4 and a third prize of £2 will be given.

Competition No. 7.—Mr. John S. Comrie, a member of the Company, offers the following prizes for a design to the scale of two inches to the foot of an improved pair-horse, top-seated tramway car (set of working drawings). Improvements in traction, life-guarding, ventilating, ease of access, lighting, &c., are suggested, and will be taken into account in making the award. A written description should accompany the design in explanation. First prize, £7. Second prize, £3.

Competition No. 8.—An extra prize of 10s. will be given to each prize winner if his model or drawing be accompanied by a sufficiently well-executed outline drawing (not shaded) of a bold scroll, ornament, or decoration, on paper 24 inches by 18 inches.

The above prizes, where not otherwise mentioned, will be accompanied by the certificate of the Company.

All drawings and models are to be delivered free at the Hall of the Company, Noble-street, St. Martin's-le-Grand, London, on or before the 30th day of April, 1895.

BANKING OPERATIONS IN CHINA.

Her Majesty's Secretary of Legation at Peking, says in his last report that the real currency of China is silver. At the southern ports the Mexican dollar is in use, but not at Shanghai or in other ports, where *taels* (otherwise known as *sycee*) are the currency in vogue. These consist of shoe-shaped lumps of silver of various degrees of purity and corresponding value. Those used in Peking are cast or moulded in private melting houses, and are stamped by the bankers who issue them. In China there is no government supervision of banking. For all small transactions, the token copper cash currency, issued by the Government,

is in universal use. During the Taiping Rebellion, the supply of copper from the mines was cut off and Peking was deprived of the means of issuing cash. A serious crisis occurred, and paper money of nominal value was at a discount, whilst copper coin rose to a premium, and was scarcely to be obtained. The Imperial Government of the day, struck a large quantity of iron cash, which they attempted to force upon the people. The latter forcibly resisted, and there was almost a revolution in the capital. The spurious iron cash was flung indignantly and broadcast into the mud or dust, which lies a foot deep in all parts of the city, and it is picked up almost in handfuls to this day by children, who use it as a plaything. The Chinese carry strings of copper cash for their daily expenditure (5 cash = 1 cent, so that 500 cash = 1 dollar = about 2s. 10d.). The silver *sycee* is made to value 10 taels in the north, and 50 taels at Shanghai and in the south (1 tael = about 3s. 8d.). It can be cut up into smaller values, and is weighed and sometimes assayed in business transactions, as is also the Mexican dollar in places where it is not usual currency. Paper notes are also extensively used, varying in value from 1 tiao (10 cents) up to 1,000 taels. Bank notes are also subject to no Government supervision whatever, and are issued by private banks of any and every kind, the only security being the individual credit, private or public, enjoyed by the issuer. Men have been known to start a bank in China, and even issue bank notes, with a capital of not much over £10 sterling. In Peking there are four great Chinese banks known as "The four Hengs." They act more or less in co-operation, and rule the money market to no small extent. They have existed and flourished for over 100 years, and so good is their credit that they enjoy a practically unlimited power of note issue, which gives them immense advantages in holding specie until the market is favourable. Notes issued and accepted are stamped with the "chop" or seal of every bank through which they pass, the chop being an acceptance of responsibility for the value indicated on the bank note. Thus forgeries or repudiations can be quickly and easily traced to their origin. The Bourse or Stock Exchange at Peking is conducted in a very primitive and original manner. Shortly after dawn a number of the principal financiers, or their representatives, meet in the Chinese city and fix the rate of exchange and current values for the day by mutual consultation, bidding, and deliberation. A flock of carrier pigeons is then liberated to carry the quotations to the principal banks throughout the capital, before they open their doors for business. The native bankers, however, have not been slow to discover that foreign financiers were ahead of themselves—by means of the telegraph—in knowledge of rates of exchange, and quickly availed themselves of the same method of communication. The rate of interest on loans is from 8 per cent. to 15 per cent., according to the security given; in cases such as loans to members of the Imperial household, as much as 20 per cent. would be charged. A large amount of

gold comes to Pekin as dust, from the washings on the Chinese side of the Amoor river and partly smuggled across the Russian frontier. It is melted down in Pekin in the shape of small bars, of ten taels weight, about the size of a sponge cake finger biscuit, and has nominally a per-centage of $98\frac{1}{2}$ pure gold,

THE RAMIE INDUSTRY IN FRANCE.

The United States Consul at St. Etienne says, in a recent report to his Government, that a French society was formed, some years ago, to develop the cultivation of ramie in Spain and Egypt, two countries affording most favourable conditions of soil and climate. The Spanish proprietors willingly consented to the experiment; but, being absolutely without the necessary means, they had to draw largely from the treasury of the society, and, at last growing discouraged, the experiment was abandoned. In Egypt, success was not greater. Although the plant took kindly to its new home, the cost of irrigation became very onerous, and, in the end, the society had to go into liquidation, after having lost 4,500,000 francs. In the meantime, a manufactory, for the spinning of ramie thread, and converting it into tissues, such as sailcloth, table linen, curtains, &c., was organised at Avignon. The creditors of the society in liquidation, believing that the ramie industry would succeed in the end, abandoned to a new board of directors the factory for a certain number of years, on the condition that a large portion of the dividend should be appropriated to the extinction of the debt, which amounted to 600,000 francs. There is already, says the United States Consul, every hope of success. Abandoning all idea of establishing plantations in Europe, the company imports the raw material direct from China, where it has already passed through the first and somewhat incomplete operation of decortication. On its arrival at the factory, it is passed a second time through a decorticating machine, of which M. Favier, the manager of the company, is the inventor, and finally relieved of all the glutinous matter by a chemical process, of which M. Favier keeps the secret, but which is supposed to consist of a weak alkaline solution, in which the fibres are boiled. It is then spun into thread, when it is ready for manufacturing the articles already mentioned. The factory employs at present about 200 hands, men and women, and the business done represents a value of about 1,000,000 francs (£40,000) annually. Manufactured ramie is a little dearer than cotton or linen goods, but its durability is said to be threefold that of the latter. It is claimed that it will always preserve the original gloss. The factory does not, it is said, intend to continue the manufacture of tissues, but will confine its business to spinning, so as to furnish the large weaving industries with thread. The actual price of the thread ranges from 4 to 12 francs per kilo-

gramme (from 1s. 6d. to 4s. 6d. per pound), but the company asserts that as soon as the cultivation of ramie becomes developed in other countries (South America especially) these prices will be much lowered. Besides this branch of the industry, the company manufactures ramie pulp for the making of paper of all kinds, but especially for that intended for bills of the Bank of France. This bank has made a contract with the company, by which the latter is obliged to keep in stock for the bank 20,000 kilogrammes of pulp in one of the bank's large store-rooms at Marseilles, and to have on hand 20,000 kilogrammes more, while the bank itself has always a similar amount in its paper manufactory near Paris, making in all 60,000 kilogrammes at all times available. The price of the pulp is six francs per kilogramme (about 2s. 3d. per pound), and it is said that the notes made with this material are not only stronger than others, but they defy imitation. The company is at present in negotiation with the Russian Government on the subject of the supply of pulp for use in making paper for the Bank of Russia. At the present day, although both climate and soil are adapted to its production, ramie is practically uncultivated in France. Some years ago, when the vineyards were ravaged by the phylloxera, and before the American vine was introduced, cultivators, in some of the districts of the south of France, replaced the vine stocks by those of ramie, in order to utilise the ground. As soon, however, as it was discovered that the American vine was invulnerable to the attacks of the phylloxera, the experiment of cultivating ramie was abandoned, as the cultivation of the vine was so much more profitable.

Correspondence.

LIQUID FUEL.

Would you kindly allow us to reply to a statement in your *Journal*, made by Mr. Edwin Henwood in a discussion on "Liquid Fuel" in the *Journal* of date 29th June (see p. 704). He writes:—"Finally it is to be noted that the crude arrangements which were in use last year on the Clyde steamers should not be allowed to influence the minds of people, as if the perfected system [*i.e.*, his system] had been employed a very different result would have been recorded."

We fitted up the steamer referred to, and we may say on the authority of Captain Williamson, the marine superintendent of the Caledonian Steam Packet Company (Limited), under whose inspection the work was carried out, that the whole arrangements were an absolute and unqualified success. How your correspondent could truthfully say the arrangements were crude we are at a loss to imagine. He never saw them, and evidently knows nothing about them.

We cannot allow such reckless assertions to pass

unchallenged; and would esteem it a favour if you would allow us to give an emphatic denial to the slipshod statements of the gentleman referred to.

A. AND C. STEWART.

Port-Eglinton Foundry, Victoria-street, Glasgow,
12th November, 1894.

Obituary.

SIR DANIEL ADOLPHUS LANGE.—Sir Daniel Lange, who died suddenly on Friday, 2nd inst., was the second son of the late Mr. John William Lange, who was descended from an old Amsterdam family. He was born in 1821. He was appointed in 1858, by Said Pasha, late Viceroy of Egypt, constructor of the Suez Canal, and was for some years director in England of that work, on the completion of which he received the honour of knighthood. In 1871, he received the Second Class of the Order of the Medjidieh from the Sultan, was named a Knight of the Crown of Italy, and a Knight Commander of the Order of Isabel of Spain in 1872, and a Grand Officer of the Lion and Sun of Persia in 1873. He was the author of "Reflections on the Desert," "The Suez Canal viewed in its Political Bearings," "A Narrative of the Suez Canal Works," and other publications. Sir Daniel Lange was elected a member of the Society of Arts in 1869, and on April 27th of the following year he read a paper before the Society on the "Suez Canal Works."

JOHN WALTER.—Mr. Walter, the proprietor of *The Times*, died on Saturday, 3rd inst., at Bearwood, his seat in Berkshire, after a short and painless illness. He was born at the private residence in Printinghouse-square adjoining the newspaper office, in 1818, and had, therefore, attained the age of seventy-six. He was educated at Eton, where he was captain of the oppidans, and graduated with honours at Exeter College, Oxford, taking his M.A. degree in 1843. He was M.P. for Nottingham from 1847 to 1859, when he was elected for Berks. After the dissolution of 1885, he did not offer himself for re-election. A full obituary notice of Mr. Walter was given in *The Times* for November 5th, and the facts of his life are so well known, and have been so widely noticed in the Press, that it is not necessary to do more than mention that he was elected a member of the Society of Arts in 1879. In the appreciative memoir in *The Times*, it is said:—"For hard upon half a century Mr. Walter's voice has been always a potent voice, in the last resort a deciding voice, in the policy and conduct of this journal."

MEETINGS FOR THE ENSUING WEEK.

MONDAY, NOV. 19.—Royal Institution, Albemarle-street, W., 3 p.m. General Monthly Meeting, 5 p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m. Lantern Evening.

Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Prof. Wynter Blyth, "Diseases of Animals in Relation to Meat Supply, &c."

British Architects, 9, Conduit-street, W., 8 p.m. Mr. F. M. Grattan, "Notes upon the Architecture of China."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. W. Martin Conway, "Climbing in the Himalayas."

TUESDAY, NOV. 20.—Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Albert J. Durston, "The Machinery of War Ships."

Statistical, Geological Museum, Jermyn-street, S.W., 4½ p.m. Lord Farrar, "The Relations between Morals, Economics, and Statistics."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

WEDNESDAY, NOV. 21.—SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Opening Meeting of the 141st Session. Address by Sir John Donnelly, Chairman of Council.

Meteorological, 25, Great George-street, S.W., 7½ p.m. 1. Mr. H. B. Guppy, "Methods of Determining the Influence of Springs on the Temperature of a River, as Illustrated by the Thames and its Tributaries." 2. Mr. Eric S. Bruce, "Some Effects of the Gale in the Highlands of Scotland on November 17th and 18th, 1893."

Geological, Burlington-house, 8 p.m.

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Mr. E. M. Nelson, "A Simple Method of Measuring the Refractive Indices of the Media." 2. Dr. W. A. Turner, "Demonstration on Staining Central Nervous System." (With lantern.)

Archaeological Association, 32, Sackville-street, W., 8 p.m.

Institute of Mining and Metallurgy, Geological Museum, Jermyn-street, S.W., 8 p.m. Mr. Manuel Eisler, "The Practical Operation of the Cyanide Process on the Witwatersrand (Transvaal) Gold-fields."

Sanitary Institute, 74A, Margaret-street, S.W., 8 p.m. Dr. E. A. Seaton, "Infectious Diseases and Methods of Disinfection."

Inventors' Institute, 27, Chancery-lane, W.C., 8 p.m.

THURSDAY, NOV. 22.—Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Rev. H. N. Hutchinson, "Extinct Monsters."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. Charles S. du Riche Preller, "Electrical Steep Grade Traction in Europe." 2. Mr. H. D. Wilkinson, "Notes on Electric Tramways in the United States." 3. Messrs. R. W. Blackwell and Philip Dawson, "Electric Traction with special reference to the Installation of Elevated Conductors."

Camera Club, Charing-cross-road, W.C., 8 p.m. Mr. T. C. Hepworth, "Vertical Camera Work."

FRIDAY, NOV. 23.—Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Dr. J. F. Sykes, "Objects and Methods of Inspection."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Science Schools, South Kensington, S.W., 5 p.m. 1. Mr. Fredk. Womack, "The Measurement of Electromagnet Capacity." 2. Prof. S. P. Thompson and Mr. Miles Walker, "Mirrors of Magnetism." 3. Prof. Ayrton and others, "Students' Simple Apparatus."

SATURDAY, NOV. 24.—Botanic, Inner-circle, Regent's-park, N.W., 3½ p.m.

CONTRIBUTIONS TO THE READING-ROOM.

The Council beg leave to acknowledge, with thanks to the Proprietors, the receipt of the following Transactions of Societies and Periodicals.

TRANSACTIONS, &c.

- American Chemical Society, Journal.
 American Institute of Electrical Engineers, Transactions.
 American Philosophical Society, Proceedings and Transactions.
 American Society of Civil Engineers, Transactions and Proceedings.
 Association of Engineering Societies, Journal.
 Australasian Association for the Advancement of Science, Report.
 Bath and West and Southern Counties Society, Journal.
 Birmingham Philosophical Society, Proceedings.
 British Association for the Advancement of Science, Report.
 British Guiana, Royal Agricultural and Commercial Society of, Journal.
 British Horological Institute, Horological Journal.
 Camera Club, Journal.
 Canada, Royal Society of, Proceedings and Transactions.
 Canadian Institute, Transactions.
 Canadian Society of Civil Engineers, Transactions.
 Chartered Institute of Patent Agents, Transactions.
 Chemical Society, Journal.
 Cleveland Institution of Engineers, Proceedings.
 East India Association, Journal.
 Farmers' Club, Journal.
 Franklin Institute, Journal.
 Geneva, Société des Arts, Bulletin de la Classe d'Industrie et de Commerce.
 Geological Society, Quarterly Journal.
 Glasgow Philosophical Society, Proceedings.
 Imperial Institute, Year Book.
 Incorporated Gas Institute, Transactions.
 India, Geological Survey of, Memoirs, Records and Palæontologia Indica.
 Indian Meteorological Department, Report.
 Institute of Bankers, Journal.
 Institute of Brewing, Transactions.
 Institution of Civil Engineers, Minutes of Proceedings.
 Institution of Electrical Engineers, Journal.
 Institution of Engineers and Shipbuilders in Scotland, Transactions.
 Institution of Mechanical Engineers, Proceedings.
 Institution of Mining and Metallurgy, Transactions.
 Institution of Naval Architects, Transactions.
 Iron and Steel Institute, Journal.
 Jamaica, Institute of, Journal.
 Japan, College of Science, Imperial University, Journal.
 Japan Society, Transactions and Proceedings.
 Junior Engineering Society, Record of Transactions.
 Kew Gardens Bulletin.
 Linnæan Society, Journal.
 Liverpool Polytechnic Society, Journal.
 London Association of Foremen Engineers and Draughtsmen, Publications.
 Manchester Literary and Philosophical Society, Memoirs and Proceedings.
 Massachusetts Institute of Technology, Technology Quarterly and Proceedings of the Society of Arts.
 Munich, Polytechnischer - Verein, Bayerisches Industrie-und-Gewerbeblatt.
 National Association for the Promotion of Technical and Secondary Education, Record.
 National Indian Association, "The Indian Magazine."
 Nederlandsche Maatschappij ter Bevordering van Nijverheid, Wekelijkoche Courant de Nijverheid.
 New South Wales, Royal Society, Journal and Proceedings.
 North-East Coast Institution of Engineers and Shipbuilders, Transactions.
 Paris, Conservatoire des Arts et Metiers, Annales.
 —, Société de Géographie Commerciale, Bulletin.
 —, Société Internationale des Electriciens, Bulletin.
 —, Société Nationale d'Acclimatation de France, Revue.
 Patent-office, Illustrated Official Journal.
 Pharmaceutical Society, Journal and Transactions.
 Philadelphia, Academy of Natural Sciences, Proceedings.
 —, Engineers' Club of, Proceedings.
 Physical Society of London, Proceedings.
 Quekett Microscopical Club, Journal.
 Royal Agricultural Society, Journal.
 Royal Colonial Institute, Proceedings.
 Royal Cornwall Polytechnic Society, Annual Report.
 Royal Geographical Society, "The Geographical Journal."
 Royal Institute of British Architects, Journal.
 Royal Institution of Great Britain, Proceedings.
 Royal Irish Academy, Transactions and Proceedings.
 Royal Meteorological Society, Quarterly Journal.
 Royal National Life Boat Institution, "The Life Boat."

Royal Photographic Society of Great Britain, Journal.
 Royal Scottish Society of Arts, Transactions.
 Royal Society, Philosophical Transactions and Proceedings.
 Royal Society of Edinburgh, Transactions and Proceedings.
 Royal Statistical Society, Journal.
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